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ABSTRACT

The Total Objective Plan for the Officer Procurement System (TOPOPS) is an aggregate-level, computer-based model of the Air Force Officer procurement system developed to operate on the UNIVAC 1108 system. It is designed to simulate officer accession and training and achieve optimal solutions in terms of either cost minimization or accession quality maximization over a five-year procurement period. The technical description specifies the objective functions and constraints in symbolic terms. The constraints are categorized as: quality distribution, program budget, supply, requirements, policy, and operating constraints. A hypothetical sample problem for minimizing cost is presented and the results are discussed. The problem is also subjected to sensitivity analysis which examines the impact of various policies on cost and accession quality. The computer generated reports are included in the appendix. (Author/SA)

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A TECHNICAL DESCRIPTION OF THE OFFICER PROCUREMENT MODEL (TOPOPS)

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This technical report presents a more comprehensive mathematical formulation of the TOPOPS model than is contained in an earlier report, AFHRL-TR-73-73, "A Conceptual View of the Officer Procurement Model (TOPOPS)." TOPOPS is an aggregate-level, computer-based model of the Air Force officer procurement system developed to operate on the UNIVAC 1108 system. It is designed to simulate officer accession and training and achieve optimal solutions in terms of either cost minimization or accession quality maximization over a five-year

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procurement period.

The technical description specifies the objective functions and constraints in symbolic terms. The constraints are categorized as quality distribution constraints, program budget constraints, supply constraints, requirements constraints, policy constraints, and operating constraints. A hypothetical sample problem for minimizing cost is presented and the results are discussed. The problem is also subjected to sensitivity analysis which examines the impact of various policies on cost and accession quality. The computer-generated reports are included in the Appendix.

PREFACE

This report is one of four reports prepared under a contract study entitled "Development of an Operational Model of the Officer Procurement System (TOPOPS)," #F41609-72-C-0042, conducted by System Automation Corporation, Silver Spring, Maryland. Mr. Allan Akman was the Principal Investigator for the study. Mr. Alfred Rubin and Mr. Mike Regardie, of System Automation Corporation, provided extensive support for this research effort.

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I.

INTRODUCTION

A. Overview

This report consists of three chapters including this introductory chapter.

Chapter II presents a complete mathematical description of the TOPOPS[1] model. This description coincides with the conceptual model of the procurement system and is compatible with the TOPOPS computer programs.

Chapter III discusses the cost and quality sensitivity analysis of the officer procurement system model to several operating and policy decisions. This analysis was based on a series of TOPOPS runs utilizing a hypothetical Air Force problem.

B. Conceptual View

The analysis upon which this report is based utilizes the TOPOPS computer model documented in a Technical Report, entitled, "A Conceptual View of the Officer Procurement Model (TOPOPS), AFHRL TR 73-73. Analysts and user/operator guides have also been prepared for the TOPOPS model. These guides are available upon request from AFHRL/Lackland.

TOPOPS is a linear programming model designed and developed for use on the UNIVAC 1108 system. The model determines an optimal procurement schedule which minimizes program costs or maximizes average entry-level quality subject to numerous user-specified constraints over a five-year time frame.

The basic costing concept used in TOPOPS is program cost. This cost is incurred directly and indirectly from the time an officer candidate enters a commissioning source to the time he completes his

[1] The acronym TOPOPS stands for: Total Objective Plan for the Officer Procurement System

initial flying or technical training. "Cost per graduate" factors for the production and training stages are used to estimate program costs. These per-unit cost factors include both the direct and indirect costs as well as account for an attrition rate.

Several extensions of the basic cost concept have to be made in order to achieve an appropriate program cost function to TOPOPS.

First, production cost by its very nature is not a comprehensive measure of the costs of a particular set of procurement decisions. Because these decisions have long-run implications which do not show up until years later, focusing strictly on production costs as an objective function in an optimization model can result in a suboptimization. While it is beyond the scope of this effort to delve extensively into the long-term effects of procurement decisions, the cost function can, however, be modified to reflect the costs of replacement at some point in the future. Therefore, if a commissioning source produces officers whose average career length is short, its cost function in the short run can be penalized to reflect this eventuality. This model uses twenty-year turnover rates for this purpose. Turnover rates are defined as the number of times an officer for the various commissioning sources must be replaced in a twenty-year time frame.

Second, as already noted in the description of officer flow, procurement for any one year involves decisions made and training programs conducted over the preceding four or five years. The production costs minimized by TOPOPS are the program costs incurred to meet procurement requirements. The cost function is not time-phased, however, to represent annual budget costs but aggregated to equal total program costs.

The seven[2] major commissioning sources for which TOPOPS has been tested include the following:

AFROTC - 2 Year Program
AFROTC - 4 Year Program
SMSO - Non-Prior Service (NPS)
SMSO - Airman Commissioning Program (ACP)
SMSO - Airman Education and Commissioning Program (AECP)
SMSO - Bootstrap Commissioning Program (BCP)
United States Air Force Academy - (USAFA)

[2] Other delineations of the commissioning sources may be specified by the user.

Because of the generalized nature of the model the analyst is in no way restricted to these specific commissioning sources.

The TOPOPS quality concept focuses on entry-level quality and is operationalized using various devices and assumptions. These include the following:

1. Due to limited data, TOPOPS now addresses the measurement of officer candidate quality at the time of their entry into the various commissioning sources.

2. The present method for measuring quality in the TOPOPS context is through the use of AFOQT scores. Based on past research, it is generally accepted that officer candidates with higher AFOQT scores will have a greater probability of success than candidates with lower scores.

3. We assume supply pools can be characterized by a distribution of AFOQT scores.

4. The AFOQT is no more than a partial measure of quality and hence, treatment of the quality concept should be extended beyond the use of AFOQT scores.

5. Two measures of extending the quality concept used in TOPOPS are the inclusion of selective recruitment and selective procurement. Selective recruitment assumes that the Air Force will be required to obtain officer candidates from different supply pools (e.g., quotas from various sub-groups of the U.S. population) and that some people with somewhat lower AFOQT scores than would be selected if quotas were not imposed can and will make successful AF officers. Selective procurement is used to insure that all commissioning sources provide at least some minimum proportion of the requirements.

6. An additional means for extending the quality concept is to define the supply pools in terms of parameters other than AFOQT scores. These may include physical, mental, moral, and educational standards.

These then, are the means for addressing the quality concept in TOPOPS. Although this is not a wholly satisfactory approach, it enables us to model some of the principal procedures used by personnel planners to achieve a quality force.

Until an improved operational concept of quality is developed, the approach mapped out here appears as satisfactory as is possible. We do not regard this approach as "optimizing quality" but as a set of techniques which if used judiciously, raise the probability of achieving a quality officer force.

The general structure of the model appears in Table 1. As shown, there are two objective functions and five sets of constraints. The analyst chooses among these to formulate his problem.

The model provides a choice between two objective functions. The first minimizes total program cost. The other maximizes entry-level quality of officers as measured by average AFOQT scores.

Five sets of constraints are considered. The first set is designed to represent a series of program budget constraints which assure that expenditures for procurement do not exceed specified levels. The second set consists of quality distribution constraints. These constraints are designed to force procurement of officer candidates exhibiting a range of average AFOQT scores.

The other sets of constraints deal with supply, procurement requirements, and policy and operating characteristics of the procurement system. The third set of constraints, supply, reflects limitations on the production of officers resulting from the size of supply pools and the ability of different commissioning sources to recruit men from particular pools. A fourth set, the requirements constraints, specifies minimum production levels which must be achieved in order to provide sufficient commissioned officers to meet the procurement requirements established by the Air Force. Finally, the policy and operating constraints reflect limitations in the production capacities of the various commissioning sources as well as explicit policies to assure that certain supply pools and certain commissioning sources provide either minimum or maximum numbers of officers.

Table 1

GENERAL STRUCTURE OF TOPOPS MODEL

Model Component	Description	Ref.
Objective	MINIMIZE: Total Production Costs MAXIMIZE: Overall quality of officers produced	II. 1 II. 2
Constraint	SUBJECT TO:	
	Quality Distribution	II. 3
	Annual Budgets	II. 4
	Supply of officer candidates:	
	1. to each commissioning source 2. from each supply pool	II. 5 II. 6
	Training requirements	II. 7
	Policy and Operating characteristics	
	1. Agency restrictions 2. Selective production 3. Selective recruitment	II. 8 -9 II. 10-11 II. 12-13

TOPOPS solution variables specify optimal procurement schedules. The schedule indicates a mix of commissioned officers of different types produced by the various commissioning sources. The model either minimizes cost or maximizes quality while satisfying the various constraints.

C. Summary: The TOPOPS Design

The TOPOPS computer model may be operated in one of two modes by formulating the objective function to either minimize program costs or maximize entry-level quality. A brief discussion of these objective functions and five sets of possible constraints follows. A detailed non-technical discussion may be found in a companion technical report, entitled, "A Conceptual View of the Officer Procurement Model (TOPOPS)", AFHRL TR 73-73.

II.

TOPOPS: THE MATHEMATICAL MODEL

A. Introduction

This chapter is written to satisfy the needs of two audiences. One is the set of users who require a detailed explanation of the mathematical logic of TOPOPS. Second are the program analysts responsible for the maintenance and operation of the analytical and computer model.

The central module of TOPOPS is the Procurement Policy Generator which is basically a linear programming algorithm. This chapter provides its complete specifications. The model determines the optimal procurement schedule of officers by commissioning source in order to meet requirements for five different types of officers over any five-year period.

Paralleling the structure of the linear program, the formulation of the model here focuses on the key structural elements. These include the solution variables, the objective function, and the constraints.

B. Solution Variables

The TOPOPS Procurement Policy Generator is a generalized linear programming model which determines production and recruitment levels for each commissioning source and officer type. The model is generalized in the sense that it includes the capability of filling requirements for up to five officer types from as many as ten commissioning sources.

The optimal procurement mix is specified by two types of solution variables pertaining to recruitment flows and commissioning source production symbolically defined as:

f_{kijt} = the number of candidates taken from supply pool k for type i officers by commissioning source j to meet year t procurement requirements.

x_{ijt} = the number of commissioned officers of type i produced by commissioning source j for year t procurement requirements.

When an optimal solution is determined, the values of these variables represent a recruitment and production policy which optimizes an objective function, either minimizing program cost or maximizing a measure of officer entry-level quality, while satisfying various qualitative and quantitative constraints.

The model is time-phased over five years. The first year of the five-year model period, termed the base year, is denoted t_B with subsequent years labeled t_B+1, $t_B+2, \ldots, t_B+4$. Because the total time required for preparation in a commissioning source plus specialized training (such as UPT/UNT) can be as much as five years, the model considers decisions which can occur in any of the ten years between t_B-5 and t_B+4.

These time lags in the officer procurement system affect the TOPOPS model in two ways. First, the subscript t must be carefully defined to refer to the year in which the procurement requirement exists. When t is associated with the variables d_i, x_{ij}, and r_{ij}, it refers not to the years in which the training requirements, officer production, and recruiting requirements respectively occur, but rather to the year in which the officers generated by these activities will be available to satisfy procurement requirements.

Second, the subscript y is used to indicate the year in which recruitment, training and other activities occur in order to meet the procurement requirement in year t.

We caution the reader to understand these two time subscripts, t and y in order to more easily interpret the mathematical formulation.

C. Objective Function

The model includes two alternative objective functions. One minimizes total program cost. The other maximizes a measure of the overall quality of candidates entering the commissioning sources. In either case, the objective function is formulated in conjunction with program budget constraints and/or quality distribution constraints.

The TOPOPS cost function minimizes five-year program cost. The program cost for a particular year is the total production and training cost for meeting the procurement requirements in that year. The cost is spread over the years during which the officer is engaged in his commissioning and training program.

The mathematical formulation of the objective function is as follows:

$$(\text{II}.1) \quad \sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \sum_{j=0}^{10} \left[c_j + \sum_{i=1}^{5} c_{i'} \, \gamma_{i'i} \right] (1+I)^{t-t_B} \, T_{ij} \, x_{ijt}$$

where:

c_j	=	production cost per source j graduate
	=	pay and allowances + other costs
c_i'	=	training cost per officer type i'
$\gamma_{i'i}$	=	training program crossflows for entering officer type i who leaves as officer type i'
I	=	estimated rate of inflation
T_{ij}	=	turnover of officers of type i from source j
x_{ijt}	=	number of commissioned officers of type i produced by commissioning source j for year t procurement requirements.

The cost function is based on four terms. There are two cost factors, one for production (commissioning) and the other for training; an inflation rate; and a turnover rate. The production cost factor, cj, is the cost per graduate of a commissioning source. The method used to determine this factor accounts for commissioning attrition.

The training cost factor used in the equation is more complicated because the basic data available is cost per graduate of a training program, which includes training attrition. Since x_{ijt} represents the number of commissioned officers entering training, the training cost factor must be weighted by the training program crossflows in order to be consistent. The inflation rate allows the user to reflect estimated price changes in the cost factors.

The officer replacement factor is included in the objective function in order to reflect potential replacement expenses by weighting the cost of commissioning sources producing officers having higher attrition rates. This is accomplished by modifying the cost function to account for turnover. Turnover is defined as a measure of the number of times the Air Force can expect to replace an officer from a particular commissioning source over a twenty-year period.

The quality function maximizes the average AFOQT score for officer candidates entering commissioning sources to meet a particular year's requirements. The function, specified in terms of the flow variables previously discussed, appears as follows:

$$\text{MAXIMIZE} \left(\sum_{k=1}^{20} \sum_{i=1}^{5} \sum_{j=1}^{10} \sum_{t=t_B}^{t_B+4} A_k f_{kijt} \right) \Big/ \left[\sum_{k=1}^{20} \sum_{i=1}^{5} \sum_{j=1}^{10} \sum_{t=t_B}^{t_B+4} f_{kijt} \right] = R$$

where: A_k = average AFOQT score for individuals in supply pool k

f_{kijt} = the number of candidates taken from supply pool k for type i officers by source j to meet year t procurement requirements.

As written, the function is non-linear since R is a function of the solution variables. However, the maximum average AFOQT score occurs when the total AFOQT score is maximized. Therefore, we define the quality function in a simpler form as follows:

$$\text{II.2} \quad \text{MAXIMIZE} \sum_{k=1}^{20} \sum_{i=1}^{5} \sum_{j=0}^{10} \sum_{t=t_B}^{t_B+4} A_k f_{kijt}$$

An objective function of this type can be improperly used if constraints are not carefully defined. The reason is that the total AFOQT score can be increased simply by recruiting more men. Every additional candidate selected from a supply pool increases the total. To prevent this, training requirements which might otherwise be defined as minimum levels which could be exceeded are formulated in a subsequent section as equalities.

D. Production Stage Inputs and Outputs

Inputs to the production system are candidates while the outputs are commissioned officers. A certain number of candidates who enter a commissioning source never become commissioned officers. Others graduate but are not qualified for the type of training for which they were recruited. This attrition and crossflow that occurs in the production stage can be viewed in the form of crossflow matrices, one defined for each commissioning source. Each matrix contains entries which indicate the proportion of candidates entering that source qualified to become the type of officer indicated by the column in which the entry appears who graduate qualified for training of the type indicated by the row. We formally define the production crossflow matrix for each source j as follows:

$$P^j = P^{i'i} = \begin{bmatrix} P_{11} & P_{12} & \cdots & P_{15} \\ P_{21} & & & \\ \vdots & & & \\ P_{51} & \cdots & \cdots & P_{55} \end{bmatrix}$$

where: $P^{i'i}$ = proportion of candidates who enter source j qualified for type i and leave as type i'.

$$0 \leq P^{i'i} \leq 1$$

$$\sum_{i'=1}^{5} P^{i'i} \leq 1 \quad \text{for } i = 1, \ldots, 5$$

These matrices allow us to express the number of graduates from each commissioning source represented by the model solution variables x_{ijt} as a function of the number of candidates as follows:

$$P^j \begin{pmatrix} r_{1jt} \\ \vdots \\ r_{5jt} \end{pmatrix} = \begin{pmatrix} x_{1jt} \\ \vdots \\ x_{5jt} \end{pmatrix}$$

where: P^j = production crossflow matrix for source j

r_{ijt} = the number of candidates of type i entering source j for year t

x_{ijt} = the number of officers of type i produced by source j for year t

This system can be solved for the number of candidates as a function of the solution variables. We, therefore, have the identity relationship:

$$\begin{pmatrix} r_{1jt} \\ \vdots \\ r_{5jt} \end{pmatrix} = P^{j-1} \begin{pmatrix} x_{1jt} \\ \vdots \\ x_{5jt} \end{pmatrix}$$

The proportion of candidates who drop out of a commissioning source before graduation (the attrition rate) can be calculated explicitly as follows:

$$\text{Dropout \% for candidate of type } i = 1 - \sum_{i'=1}^{5} P_{i'i} \quad \text{for } i = 1, \ldots, 5$$

The crossflow matrices provide the capability for the conversion of a quantity of entering candidates to an equivalent number of graduates and vice versa. Consequently, keeping in mind the identity relationship, we can formulate the model relationships using either the solution variables x_{ijt} or the number of candidates r_{ijt}, whichever is more convenient. This fact allows us to more clearly and easily specify the constraints.

Figure 1 shows the crossflow matrices for an illustrative production system with only two commissioning sources, each producing two types of officers. Converting the matrix entries for source 1 to fractions for ease of calculation, we solve for the x_{ij}'s (omit t for simplicity):

$$P^1 \qquad [r_{ij}] \qquad [x_{ij}]$$

$$P^1 \begin{pmatrix} r_{11} \\ r_{21} \end{pmatrix} = \begin{pmatrix} x_{11} \\ x_{21} \end{pmatrix}$$

$$\begin{bmatrix} 3/5 & 0 \\ 1/5 & 1/2 \end{bmatrix} \begin{pmatrix} r_{11} \\ r_{21} \end{pmatrix} = \begin{pmatrix} x_{11} \\ x_{21} \end{pmatrix}$$

$$3/5\, r_{11} = x_{11}$$

$$1/5\, r_{11} + 1/2\, r_{21} = x_{21}$$

The r_{ij}'s are determined as follows:

$$\begin{pmatrix} r_{ij} \end{pmatrix} \qquad \left[P^1\right]^{-1} \begin{pmatrix} x_{ij} \end{pmatrix}$$

$$\begin{pmatrix} r_{11} \\ r_{21} \end{pmatrix} = \left[P^1\right]^{-1} \begin{pmatrix} x_{11} \\ x_{21} \end{pmatrix}$$

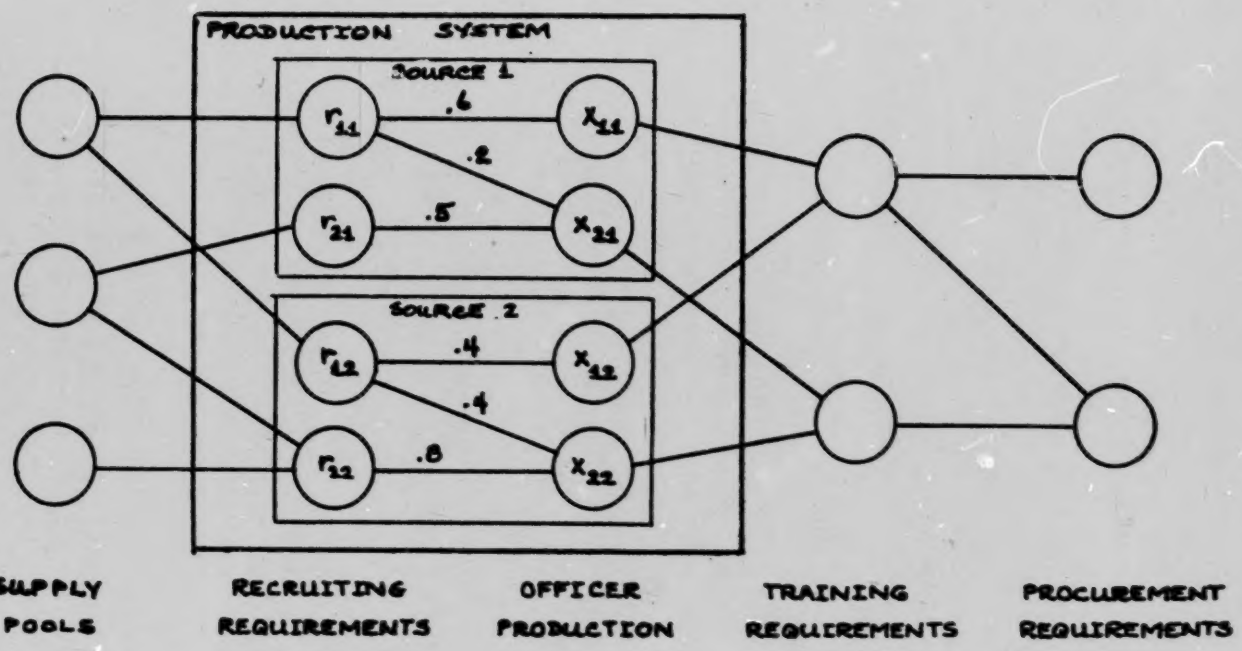
$$\begin{pmatrix} r_{11} \\ r_{21} \end{pmatrix} = \begin{bmatrix} 5/3 & 0 \\ -2/3 & 2 \end{bmatrix} \begin{pmatrix} x_{11} \\ x_{21} \end{pmatrix}$$

$$r_{11} = 5/3\, x_{11}$$

$$r_{21} = -2/3\, x_{11} + 2\, x_{21}$$

Figure 1

Relationship Between Commissioning Source Candidates and Graduates



PRODUCTION CROSSFLOW MATRICES

SOURCE 1

TYPE LEAVE \ TYPE ENTER	1	2
1	.6	0
2	.2	.5

SOURCE 2

TYPE LEAVE \ TYPE ENTER	1	2
1	.4	0
2	.4	.8

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E. Constraints

The values which the solution variables can assume are limited by the constraints in the TOPOPS model. There are five basic types of constraints relating to candidate quality, program budget limitations, the supply of officer candidates, training requirements, and the operating characteristics of commissioning sources.

Having selected an objective function which optimizes either program cost or officer candidate entry-level quality, the personnel analyst may choose to constrain the item which is not optimized. Although they can be used in formulating TOPOPS problems regardless of the objective function, the quality distribution and program budget constraints are used for this purpose.

1. Quality Distribution Constraints. The minimum proportions of the total recruitment requirement which should be filled with candidates from particular supply pools are specified using quality distribution constraints. They can be used to insure that individuals entering the force are selected from candidates with a wide range of AFOQT scores. Usually this set of constraints is used with the cost minimization objective function. The basic mathematical formulation for these constraints appears as follows:

$$\text{(II.3)} \quad \sum_{i=1}^{5} \sum_{j=1}^{10} f_{kijt} \geq \pi_{kt} \sum_{i=1}^{5} \sum_{j=1}^{10} r_{ijt} \quad \text{for } k = 1, \ldots, 20 \quad t = t_B, \ldots, t_B + 4$$

where: $\sum_{i=1}^{5} \sum_{j=1}^{10} f_{kijt}$ = total number of candidates taken from supply pool k for year t procurement requirements.

π_{kt} = proportion of the total recruitment which should be filled with candidates from supply pool k for year t procurement requirements.

$\sum_{i=1}^{5} \sum_{j=1}^{10} r_{ijt}$ = total recruitment for year t procurement requirements.

2. Program Budget Constraints. The costs of procuring and training officers to meet requirements in a specific year may be constrained by a program budget limit. Important to understand is the nature of the TOPOPS costs. These are program costs rather than budgetary or accounting type costs. The costs account for turnover and other system features which are considered important with respect to the allocation algorithm and policy analysis in terms of improving the officer force. For each year in the planning horizon there may be a program budget constraint. Usually, this set of constraints is used with the quality maximization function. The constraint is formulated in the following manner:

$$\text{(II.4)} \quad \sum_{i=1}^{5} \sum_{j=1}^{10} \left[c_j + \sum_{i'=1}^{5} c_{i'} Y_{i'i} \right] T_{ij} \, x_{ijt} \leq B_t \quad \text{for } t = t_B, \ldots, t_B + 4$$

where:

c_j	=	production cost per source j graduate
	=	pay and allowances + other cost
$c_{i'}$	=	training cost per officer type i'
$Y_{i'i}$	=	training program crossflows for entering officer type i who leaves as officer type i'
T_{ij}	=	turnover of officers type i from source j
x_{ijt}	=	number of commissioned officers of type i produced by commissioning source j for year t procurement requirements
B_t	=	program budget for year t

3. Supply Constraints. Production of the commissioning sources is constrained by the manpower resources available. Figure 2 illustrates the basic nature of supply in the procurement system. Between any supply pools S_k and any recruiting requirement r_{ij}, there is a potential relationship. Either the individuals in the pool are available to fill the recruiting requirement or S_k and r_{ij} have no relationship. We define a coefficient to reflect these two states as follows:

δ_{kyijt} = indicator of the availability of supply pool k in year y to provide candidates of type i to source j for year t procurement requirements

where: γ_{kyijt} = 1 if S_k is available to fill r_{ijt} in year y

γ_{kyijt} = 0 if there is no relationship between S_k and r_{ijt} in year y

In order to formally specify the relationships between supply and production, consider the variable defined below:

F_{kijt} = the number of candidates from supply pool k qualified for type i taken by source j for year t.

The values for the F_{kijt} represent the flow of candidates across the arcs connecting the supply pools and commissioning sources. There are potentially 5000 of these flow variables, too many to be efficiently handled by TOPOPS. It is not unreasonable, however, to limit the number of variables and hence the number of relationships between supply pools and recruiting requirements to 500. Many sources select candidates with particular officer type qualifications from only a few or just one supply pool. Similarly, most supply sources provide candidates to a small number of commissioning sources. Consequently, although there are 5000 potential relationships, limiting the number of arcs between supply pools and recruiting requirements to 500 should have no practical significance.

There are two supply constraints. The first is an identity which specifies that a recruiting requirement r_{ijt} is exactly equal to the total flow of candidates over all arcs connecting r_{ijt} to the various supply sources. The second requires that the total flow in year y of candidates from a particular supply pool S_k to all commissioning sources cannot exceed the number of potential candidates in that supply pool. Formally, the supply constraints are written:

$$\text{(II.5)} \quad \sum_{y=t_B-5}^{t_B+4} \sum_{k=1}^{20} \tau_{kyijt} \, f_{kijt} = r_{ijt} \qquad \text{for } \begin{array}{l} i = 1, \ldots, 5 \\ j = 1, \ldots, 10 \\ t = t_B, \ldots, t_B+4 \end{array}$$

$$\text{(II.6)} \quad \sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \sum_{j=1}^{10} \tau_{kyijt} \, f_{kijt} \leq S_{ky} \qquad \text{for } \begin{array}{l} k = 1, \ldots, 20 \\ y = t_B-5, t_B-4, \ldots, t_B+4 \end{array}$$

where: r_{ijt} = the number of candidates of type i entering source j for year t

S_{ky} = supply from supply pool k available to meet recruitment requirements in year y

τ_{kyijt} = indicator of availability of S_{ky} to r_{ijt}

f_{kijt} = flow of candidates from S_k to r_{ij} for year t procurement requirements

The model recognizes that the various supply pools are not constant from year to year. The number of potential candidates available from a supply source to a commissioning source for the production of officers of a particular type depends upon the year in which recruiting occurs. Consequently, the model must constrain production by the size of the supply pools available in the year in which recruitment requirements exist. The Data Initializer determines the relationship for particular procurement requirements and commissioning sources between the subscript y associated with the variables S_k and the subscript t as follows:

$$y = t - \ell_i - \ell_j$$

where: y = year in which supply pool k is available to satisfy recruiting requirements

t = year in which the procurement requirements exists

ℓ_i = number of years required for training for type i

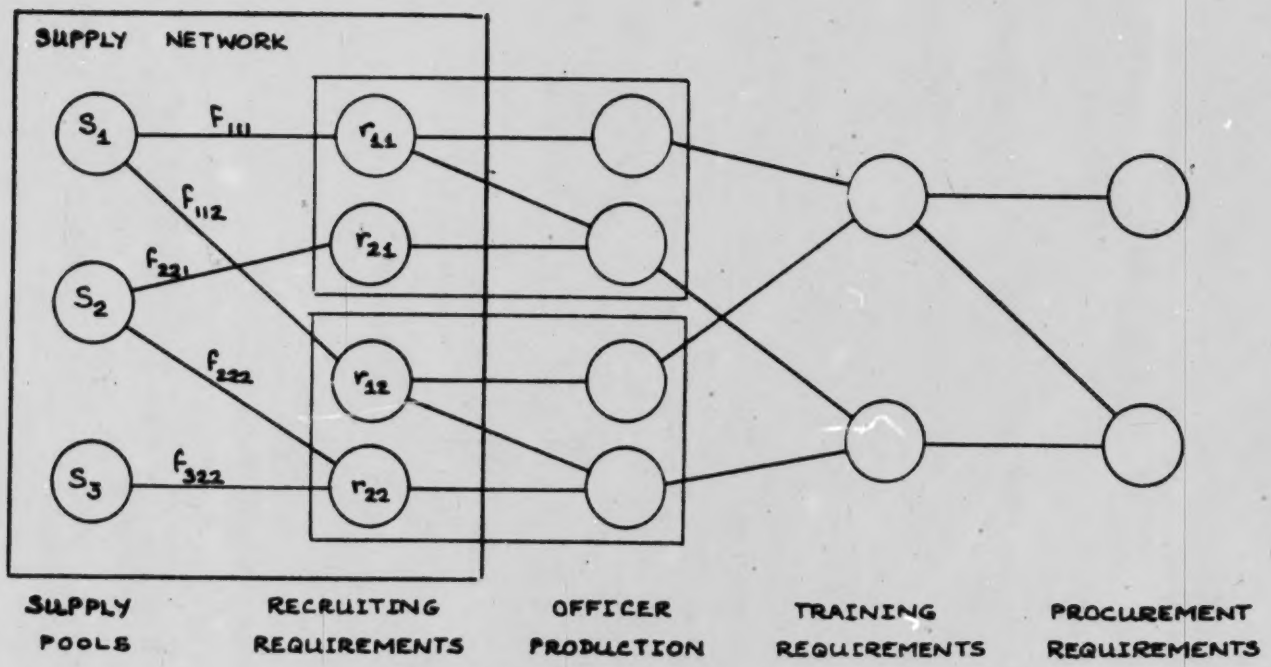
ℓ_j = number of years required for production at source j.

An example of supply constraints appears in Figure 2.

4. Requirement Constraints. Strength objectives and procurement requirements such as those generated by TOPLINE provide the basis for TOPOPS requirement constraints which specify yearly levels for officer procurement. The Data Initializer determines the total number of officers of each type who must enter training in order to meet the procurement requirements. The number required for training differs from the procurement requirements due to the attrition and crossflow which occur within the training stage.

Figure 2

Supply Relationships



SUPPLY CONSTRAINTS

(II.5)

$$f_{111} = r_{11}$$
$$f_{221} = r_{21}$$
$$f_{112} = r_{12}$$
$$f_{222} + f_{322} = r_{22}$$

(II.6)

$$f_{111} + f_{112} \leq S_1$$
$$f_{221} + f_{222} \leq S_2$$
$$f_{322} \leq S_3$$

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As previously noted, the TOPOPS solution variables must satisfy the training requirements as strict equalities to optimize quality. The general mathematical formulation for the requirement constraints are:

$$\text{(II.7)} \qquad \sum_{j=1}^{10} x_{ijt} = d_{it} \qquad \text{for } t = t_B, \ldots, t_B + 4 \quad i = 1, \ldots, 5$$

where: x_{ijt} = number of officers of type i produced by source j for year t procurement requirements

d_{it} = total number of officers of type i who must enter training to meet procurement requirements for year t

Artificial Commissioning Source and Infeasibilities. It is possible in a linear programming model for the constraints to preclude any feasible solution. This would be the case, for instance, if the supply and maximum production constraints did not permit production levels which satisfied the requirement and minimum production constraints. It is reasonable to assume, however, that excess requirements can always be satisfied by the recruitment of individuals who would otherwise be regarded as unavailable by the Air Force. Additional candidates can be acquired by either lowering standards or increasing pay. So that the model will arrive at a solution when these constraints would otherwise be binding, we specify a special commissioning source which has its own unlimited supply pool and can produce officers of any type to satisfy requirements which otherwise would not be met because of model constraints.

The cost for this hypothetical commissioning source is set at an arbitrarily high level so that when minimizing costs it is always advantegeous to completely utilize other sources first. Similarly, by assuming an average AFOQT score of zero, a quality maximization problem would select officers from this source only if no others were available. Because the production of this agency is unconstrained by supply, its inclusion as a solution variable in the requirement constraints assures that TOPOPS will always generate an optimal solution. We formally

define the following:

x_{iot} = production of officers of type i in year t from supplemental sources of candidates

Along with the inclusion of this variable in the constraints, the objective function is also modified to reflect this artificial cost. In this case, we include in the objective function the term

$$c_o x_{iot}$$

where: c_o = annual production cost of hypothetical source

$$c_o >>> c_j, j = 1, \ldots, 10$$

also: A_o = average AFOQT score of supplementary source

= 0

Infeasibilities may occur for reasons other than those addressed by the artificial source. For example, the quality distribution, selective production, and selective recruitment constraints could be specified in such a way that procurement requirements cannot be met. The complexity of the procurement system, due to crossflows and attrition, obscures the relationships between these constraints. Infeasibilities can be avoided and their causes determined if constraints are systematically introduced and their effects are analyzed before further constraints are imposed.

5. Policy and Operating Characteristics Constraints. In addition to assuring that the optimal solution satisfies training requirements within the limitations on supply, TOPOPS constraints limit the values which the solution variables can assume as a result of the operating characteristics of the various commissioning sources in the procurement system. There are three general categories of policy and operating characteristics pertaining to a) operations, b) selective production and c) selective recruitment.

a. Operating Constraints. The total production of officers by a commissioning source is restricted by capacity and economic considerations. Operating constraints reflecting these restrictions specify the smallest and largest number of officer candidates of all types that can enter a commissioning source in a given year. These constraints when specifying a minimum number of candidates establish a lower limit on entering class size; if a maximum, the constraint represents a ceiling. These constraints when used with equalities on the right-hand side, that is, the maximum and minimum levels are equal, indicate a fixed level of production for the particular source. Where appropriate, this may be interpreted and used to show current production. The constraints are formulated as follows:

$$\text{(II.8)} \quad \sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \omega_{yijt}\, r_{ijt} \geq L_{jy} \qquad \text{For } j = 1,2,\ldots,10 \quad y = t_B-5,\ldots,t_B+4$$

$$\text{(II.9)} \quad \sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \omega_{yijt}\, r_{ijt} \leq U_{jy} \qquad \text{For } j = 1,2,\ldots,10 \quad y = t_B-5,\ldots,t_B+4$$

where: ω_{yijt} = indicator that recruitment must occur in year y of officer type i for source j to meet procurement requirement in year t

= 1, if recruitment occurs in year y

= 0, if recruitment does not occur in year y

r_{ijt} = number of candidates of type i entering source j for year t procurement requirements

L_{jy} = minimum number of candidates of all types entering source j in year y

U_{jy} = maximum number of candidates of all types entering source j for year y

b. Selective Production Constraints. The second set of operating and policy constraints, selective production, allows the TOPOPS user to indicate minimum and maximum levels of production of a specific officer type by a particular commissioning source. Either a number of officers or a proportion of the training requirements for a specific officer type can be used to specify maximum and minimum production levels. Selective production constraints provide the capability for spreading procurement over a number of commissioning sources.

These constraints are formulated as follows:

$$(\text{II}.10) \quad x_{ijt} \geq M_{ijt} = \Psi_{ijt}\, d_{it} \qquad \text{For } i = 1, \ldots, 5;\ j = 1, \ldots, 10;\ t = t_B, \ldots, t_B + 4$$

$$(\text{II}.11) \quad x_{ijt} \leq N_{ijt} = \beta_{ijt}\, d_{it} \qquad \text{For } i = 1, \ldots, 5;\ j = 1, \ldots, 10;\ t = t_B, \ldots, t_B + 4$$

where: x_{ijt} = number of officers of type i produced by a source j for year t procurement requirements

M_{ijt} = minimum number of commissioned officers of type i from source j who should enter training to meet year t procurement requirements

N_{ijt} = maximum number of commissioned officers of type i from source j who should enter training to meet year t procurement requirements

Ψ_{ijt} = minimum proportion of the commissioned officers of type i from source j entering training to meet year t procurement requirements

β_{ijt} = maximum proportion of the commissioned officers of type i from source j entering training to meet year t procurement requirements

d_{it} = total number of officers of type i who must enter training to meet procurement requirements for year t

c. Selective Recruitment Constraints. Finally, the personnel analyst may want to restrict the number of candidates from a supply pool used by a given commissioning source for the production of a particular officer type. That is, the flows between the supply pools and commissioning sources may be limited. Selective recruitment constraints, which indicate the minimum or maximum number of candidates which can be recruited from a supply pool by a source for the production of officers of a particular type, provide the capability for spreading recruitment over a number of supply pools. The constraints are formed in the following manner:

$$(\text{II}.12) \qquad f_{kijt} \geq \gamma_{kijt}\, r_{ijt} \qquad \text{for } k=1,\ldots,20;\ i=1,\ldots,5;\ j=1,\ldots,10;\ t=t_B,\ldots,t_B+4$$

$$(\text{II}.13) \qquad f_{kijt} \leq \delta_{kijt}\, r_{ijt} \qquad \text{for } k=1,\ldots,20;\ i=1,\ldots,5;\ j=1,\ldots,10;\ t=t_B,\ldots,t_B+4$$

where: F_{kijt} = the number of candidates taken from supply pool k for type i by source j to meet year t requirements

γ_{kijt} = minimum proportion of the candidates which should come from supply pool k of type i entering source j for year t procurement requirements

δ_{kijt} = maximum proportion of the candidates which should come from supply pool k of officer i entering source j for year t procurement requirements

r_{ijt} = the number of candidates of type i entering source j for year t procurement requirements.

In summary, all three types of policy and operating constraints specify maximum and minimum levels for procurement system activities: operating constraints pertain to the total production of officers by a commissioning source, selective production constraints pertain to the production of officers of a particular type by a commissioning source and selective recruitment constraints pertain to the flow of candidates from supply pools to commissioning sources. In each case the TOPOPS analyst can indicate a fixed level of activity by merely specifying the desired total production, officer production or recruitment quantity using both the maximum and minimum constraints with the same right-hand side.

F. Model Summary

Figure 3 represents a summary of the TOPOPS linear programming model including formulations for the objective function and constraining relationships and definitions of the model variables, coefficients, right-hand sides and subscripts. The exact magnitude of the model for any particular application is largely determined by the number of supply pools, officer types, commissioning sources and operating limitations specified. We can estimate, however, the largest number of constraints and variables which can be included in the model. For most model runs, these estimates will greatly exceed the magnitude of the problem.

Figure 3

TOPOPS MODEL SUMMARY

MODEL FORMULATION

Optimize the objective function:

$$\text{(II.1) MINIMIZE} \sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \sum_{j=0}^{10} \left[c_j + \sum_{i'=1}^{5} c_{i'} Y_{i'i}\right] (1+I)^{t-t_B} T_{ij} x_{ijt}$$

$$\text{(II.2) MAXIMIZE} \sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \sum_{j=0}^{10} \sum_{k=1}^{20} A_k f_{kijt}$$

Subject to constraints pertaining to:

Quality Distribution

$$\text{(II.3)} \sum_{i=1}^{5} \sum_{j=1}^{10} f_{kijt} \geq \pi_{kt} \sum_{i=1}^{5} \sum_{j=1}^{10} r_{ijt} \qquad \text{FOR } k=1,\ldots,20;\ t=t_B,\ldots,t_B+4$$

Annual Budgets

$$\text{(II.4)} \sum_{i=1}^{5} \sum_{j=1}^{10} \left[c_j + \sum_{i'=1}^{5} c_{i'} Y_{i'i}\right] T_{ij} x_{ijt} \leq B_t \qquad \text{FOR } t=t_B,\ldots,t_B+4$$

Supply

$$\text{(II.5)} \sum_{y=t_B-5}^{t_B+4} \sum_{k=1}^{10} \tau_{kyijt} f_{kijt} = r_{ijt} \qquad \text{FOR } i=1,\ldots,5;\ j=1,\ldots,10;\ t=t_B,\ldots,t_B+4$$

$$\text{(II.6)} \sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \sum_{j=1}^{10} \tau_{kyijt} f_{kijt} \leq S_{ky} \qquad \text{FOR } k=1,\ldots,20;\ y=t_B-5,\ldots,t_B+4$$

Requirements

$$\text{(II.7)} \sum_{j=0}^{10} x_{ijt} = d_{it} \qquad \text{FOR } i=1,\ldots,5;\ t=t_B,\ldots,t_B+4$$

Policy and Operating Characteristics

Operations

(II.8) $$\sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \omega_{yijt}\, r_{ijt} \geq L_{jy}$$ for $j = 1, 2, \ldots, 10$; $y = t_B-5, \ldots, t_B+4$

(II.9) $$\sum_{t=t_B}^{t_B+4} \sum_{i=1}^{5} \omega_{yijt}\, r_{ijt} \leq U_{jy}$$ for $j = 1, 2, \ldots, 10$; $y = t_B-5, \ldots, t_B+4$

Selective Production

(II.10) $$x_{ijt} \geq M_{ijt} = \psi_{ijt}\, d_{it}$$ for $i = 1, \ldots, 5$; $j = 1, \ldots, 10$; $t = t_B, \ldots, t_B+4$

(II.11) $$x_{ijt} \leq N_{ijt} = \beta_{ijt}\, d_{it}$$ for $i = 1, \ldots, 5$; $j = 1, \ldots, 10$; $t = t_B, \ldots, t_B+4$

Selective Recruitment

(II.12) $$f_{kijt} \geq \gamma_{kijt}\, r_{ijt}$$ for $k = 1, \ldots, 20$; $i = 1, \ldots, 5$; $j = 1, \ldots, 10$; $t = t_B, \ldots, t_B+4$

(II.13) $$f_{kijt} \leq \delta_{kijt}\, r_{ijt}$$ for $k = 1, \ldots, 20$; $i = 1, \ldots, 5$; $j = 1, \ldots, 10$; $t = t_B, \ldots, t_B+4$

Figure 3--Continued

Variables, Coefficients and Right-hand Sides

x_{ijt}	=	the number of commissioned officers of type i produced by commissioning source j for year t
c_j	=	production cost per source j graduate
$c_{i'}$	=	training cost per officer type i'
$y_{i'i}$	=	training program crossflows for entering officer type i who leaves as officer type i'
I	=	estimated rate of inflation
T_{ij}	=	twenty-year turnover of officers of type i from source j
A_k	=	average AFOQT score for individuals in supply pool k
F_{kijt}	=	the number of candidates taken from supply pool k for type i officers by source j to meet year t procurement requirements
r_{ijt}	=	the number of candidates of type i entering source j for year t procurement requirements
B_t	=	total program budget for year t
S_{ky}	=	supply from supply pool k available to meet recruitment requirements in year y
T_{kyijt}	=	indicator of the availability of supply pool k in year y to provide candidates of type i to source j for year t procurement requirements
π_{kt}	=	proportion of the total requirement which should be filled with candidates from supply pool k for year t procurement requirements

d_{it} = total number of officers of type i who must enter training to meet procurement requirements for year t

L_{jy} = minimum number of candidates of all types entering source j in year y

U_{jy} = maximum number of candidates of all types entering source j in year y

M_{ijt} = minimum number of commissioned officers of type i from source j which should enter training to meet year t procurement requirements

N_{ijt} = maximum number of commissioned officers of type i from source j which should enter training to meet year t procurement requirements

ω_{yijt} = indicator that recruitment must occur in year y of officer type i in source j to meet procurement requirement in year t

ψ_{ijt} = minimum proportion of the commissioned officers of type i entering training which should be filled by source j to meet year t procurement requirements

β_{ijt} = maximum proportion of the commissioned officers of type i entering training which should be filled by source j to meet year t procurement requirements

γ_{kijt} = minimum proportion of the candidates which should be selected from supply pool k of type i entering source j for year t procurement requirements

Figure 3--Concluded

δ_{kijt}	=	maximum proportion of the candidates which should be selected from supply pool k of type i entering source j for year t procurement requirements

Subscripts

i	=	officer type indicator
j	=	commissioning source indicator
t	=	year in which the procurement requirement occurs
k	=	supply pool indicator
y	=	year in which recruitment, training and other activities occur to satisfy procurement requirements

From Table 2 we see that there can be as many as 2280 TOPOPS constraints and that there is a maximum of 775 structural variables. An additional 2005 slack variables yield a maximum of 2780 variables of all types.

Table 1

MAGNITUDE OF THE TOPOPS MODEL

Constraining Relationship	Ref.	No. of Constraints	Slack Variables
Quality Distribution	II. 3	100	100
Program Budget	II. 4	5	5
Supply	II. 5 II. 6	250 200	--- 200
Requirements	II. 7	25	---
Policy & Operating Characteristics	II. 8 II. 9 II. 10 II. 11 II. 12 II. 13	100 100 250 250 500 500	100 100 250 250 500 500
TOTALS		2280	2005

Number of Variables:

Solution Variables	250
Free Variables*	25
Flow Variables	500
Total Structural Variables	775

*the free variables represent procurement by commissioning source with unconstrained supply; these are introduced into the solution only when existing supply pools are insufficient to meet the requirements.

G. Interpretation of an Optimal Solution

In addition to the procurement mix specified by the solution variables, an optimal TOPOPS solution includes other important information. Slack variables convert inequality relationships to linear equations, required by the linear programming algorithm. The difference between the limited availability of a resource and the amount of that resource actually used is represented by a slack variable.

If an optimal solution satisfies a constraint as an equality, that is if production is equal to the maximum or minimum amount allowed by the constraint, then the surplus variable for that constraint will have a value of zero. On the other hand, a non-zero slack variable in an optimal solution indicates that the constraint in which it appears is satisfied as an inequality; production is less than a maximum or greater than a minimum amount allowed by the constraint. Interpretations of the slack variables associated with TOPOPS constraints appear in Table 3.

Table 3

INTERPRETATION OF TOPOPS SLACK VARIABLES

Constraining Relationship	Ref.	Interpretation of non-zero Slack Variables
Quality Distribution	II. 3	Number of candidates recruited from supply pool k in excess of the minimum proportion of the recruitment requirements specified.
Annual Budget	II. 4	Amount by which expenditures by all agencies in year y to meet TOPOPS procurement requirements fall below the available portion of the annual budget.
Supply	II. 5	None.
	II. 6	Number of individuals in supply pool k for year t not recruited by any source.
Requirements	II. 7	None.
Operating Characteristics	II. 8	Number of commissioned officers of all types produced by source j in excess of its minimum production requirement for year t.

Table 3--Concluded

Contraining Relationship	Ref.	Interpretation of non-zero Slack Variables
Operating Characteristics	II. 9	Number of commissioned officers of all types representing the excess of capacity over production by source j for year t procurement requirements.
Selective Production	II. 10	Number of commissioned officers of type i produced by source j in excess of its minimum training requirement for year t.
	II. 11	Number of commissioned officers of type i representing the excess of capacity over production by source j for year t procurement requirements.
Selective Recruitment	II. 12	Number of candidates of type i selected from supply pool k by source j in excess of the minimum portion of recruitment for year procurement requirements.
	II. 13	Number of candidates of type i which were not but could have been selected from supply pool k without exceeding the maximum portion of recruitment for year t requirements.

III.

TOPOPS SENSITIVITY ANALYSIS

A. Introduction

This chapter describes the results of a sensitivity analysis of the Air Force officer procurement system using TOPOPS: the analysis is based on a hypothetical sample problem and associated data. The data is displayed in Appendix A, as well as partially in the following pages.

The sensitivity analysis was conducted with respect to cost and quality. In the former case, we addressed the question:

> What additional cost do we incur if we attempt to improve entry-level quality?

In the second case, we ask

> What loss in entry-level quality occurs if we attempt to lower cost?

The two cases correspond to the two modes of the TOPOPS model: cost minimization and quality maximization, respectively.

Analysis in each mode proceeded through two stages. First, a base line case was established by running the hypothetical sample problem under TOPOPS without any constraints -- a completely free system.

Second, constraints were introduced to represent the procurement system as it might operate under realistic policy and procedures. Two questions were addressed at this point:

> What does it cost to operate this way?
>
> In what areas can we most significantly improve the system?

Table 4 shows the procurement requirements for 1970-74. Figure 4 illustrates the basic system structure.

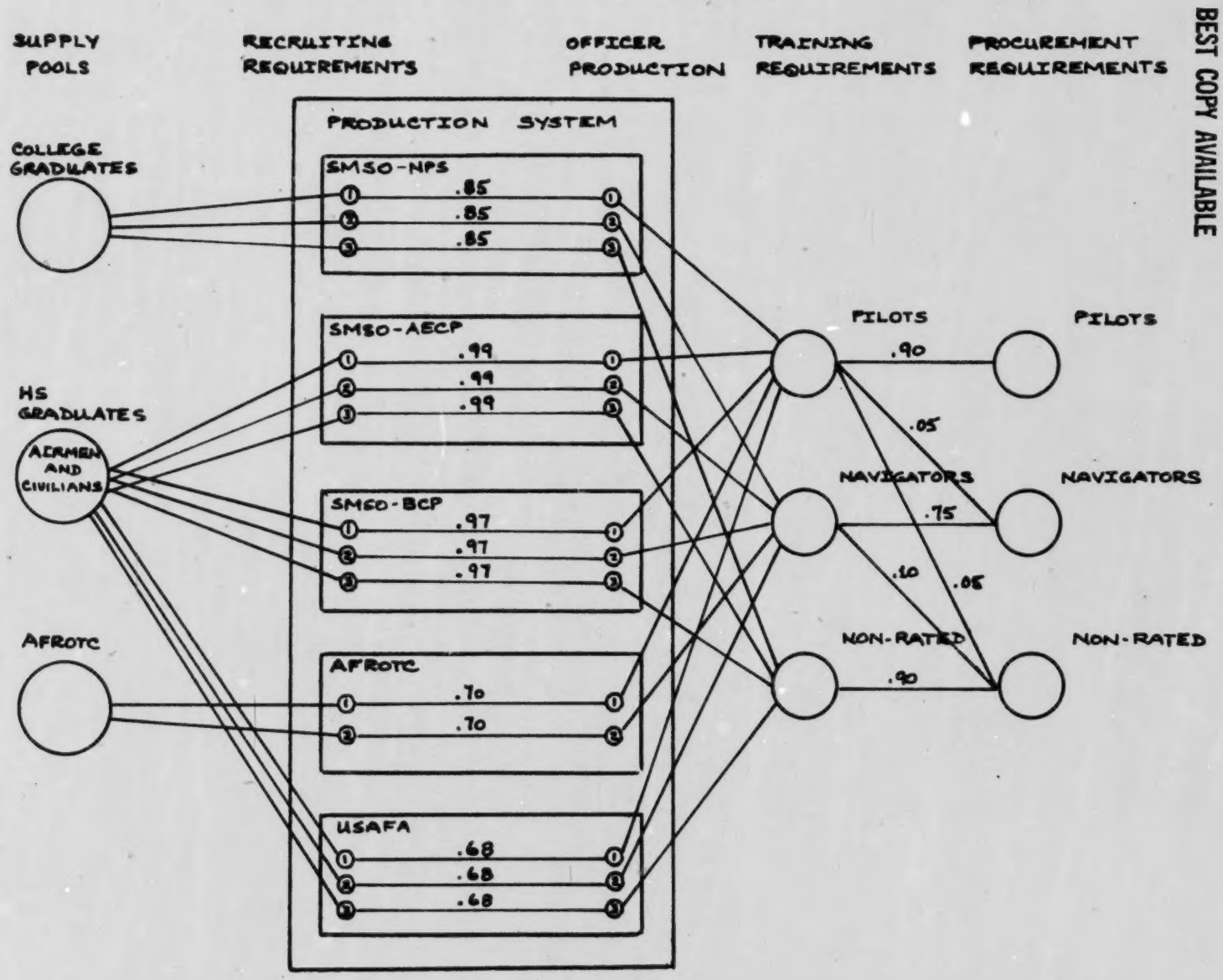
Table 4

AF Procurement Requirements
1970-74

Officer	1970	1971	1972	1973	1974	Total
Pilot	5589	4811	4085	3579	3396	21460
Navigator	867	1149	1309	1177	1440	5942
Non-rated	4295	3207	2871	3246	2638	16257
Total	10751	9167	8265	8002	7474	43659

Figure 4

TOPOPS Air Force Procurement System



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B. The Hypothetical Sample Problem Statement

The Air Force officer procurement system described by the test data includes five commissioning sources:

SMSO-NPS
SMSO-AECP
SMSO-BCP
AFROTC
USAFA

These, with the exception of AFROTC, provide three types of officers: pilot, navigator, and non-rated. AFROTC graduates only rated qualified officers for purposes of this hypothetical sample problem.

Three supply pools were specified. These include high school graduates (both airmen and civilian), AFROTC eligibles, and SMSO eligible college graduates. These pools were each divided into three groups of potential officer candidates with different average AFOQT scores, 90, 70, and 50 respectively.

C. Cost Sensitivity

To understand the rationale of the optimal procurement schedule, one must know the cost factors associated with the commissioning sources. Table 5 lists the cost coefficients. Each is computed from three basic factors:

- Procurement cost per program graduate
- Training cost per graduate
- Turnover

Changes in any of these factors will result in different cost coefficients and consequently different allocations.

Table 5 shows that in general, the USAFA is significantly more costly than any other program; SMSO-BCP is the least costly. With respect to specific officer types, certain agencies are competitive. For example, navigators can be procured from SMSO-NPS and SMSO-AECP at almost the same cost. SMSO-BCP and SMSO-NPS are fairly competitive with respect to non-rated officers.

Table 5

TOPOPS Cost Factors
(in thousands of dollars per graduate)

Officer	SMSO-NPS	SMSO-AECP	SMSO-BCP	AFROTC	USAFA
Pilot	166	102	89	176	291
Navigator	40	39	26	50	165
Non-rated	18	28	15		143

1. The Baseline Case. The starting point for this analysis was a base case designed to produce sufficient officers to meet AF requirements regardless of any quality considerations or operating constraints. Simply stated, we wanted to know the least cost means of producing officers. The only operative constraints employed in the TOPOPS model at this point were supply constraints; otherwise, the least costly officers were produced.

The total five-year program cost was $2.8 billion[3]. The average entering AFOQT score was 61. However, more significant with respect to the TOPOPS quality concept, there was an erratic and inoperable procurement pattern determined solely by the least-cost criterion.

As you would expect, SMSO-BCP and then SMSO-AECP produced approximately two-thirds of the officers; had there been larger supply pools feeding these sources, they would have produced even more. There was no production from the Air Force Academy. SMSO-NPS filled the shortfall except in 1973 and 1974 where its supply was insufficient. In these instances, AFROTC came in. Table 6 shows the distribution of officers by commissioning source.

2. The Modified System. There are policies which impact on the operation of the AF officer procurement system. Their purpose is to insure efficient officer procurement with respect to cost and quality, among other factors. The TOPOPS model can be modified using constraints to reflect these operating requirements. The effect is to raise the cost of procuring officers above the baseline case.

The baseline case was altered to reflect the following operating policies:

- the Air Force Academy has an annual entering class ranging between 900 and 910

- a ceiling on the annual size of the SMSO-BCP and SMSO-AECP program was set at 300 for each

---

[3] Remember these are program costs not annual budget costs.

- annual entering AFROTC class was between 1000 and 5000

- at least 1000 officer candidates enter SMSO-NPS each year

The effect of these policies is to limit production by the least costly commissioning sources, SMSO-BCP and SMSO-AECP, and shift production to AFROTC and SMSO-NPS. The latter source was tapped for officers to the extent that its supply pool permitted at which point AFROTC was used. The total requirements were for approximately 3000 more men than could be met given the size of the supply pools feeding the two sources and the upper ceiling of 5000 on AFROTC. Consequently, the eligible college graduate supply pool was expanded in order to increase the production capability of SMSO-NPS.

Table 7 shows the resulting procurement pattern. The complete TOPOPS output for this system configuration is included in Appendix B.

The total five-year program cost was raised to $4.9 billion, almost twice as costly as the "free" system. As can be seen from Table 7, the procurement pattern is more nearly similar to the way in which the Air Force presently procures officers. The significant changes in the procurement schedule all relate to the operating and policy constraints imposed on the system. Most notable are the following effects:

- 900 men are procured through the Air Force Academy each year

- procurement through the SMSO-AECP and SMSO-BCP programs was restricted to 300 each

The policies force procurement using the more expensive sources and restrict procurement from the least expensive. The burden of meeting the procurement requirements falls upon SMSO-NPS and AFROTC.

3. Binding System Constraints. Table 8 summarizes the sensitivity of the officer procurement system represented in the hypothetical sample problem to various system constraints. Increasing the number of eligible college graduates for SMSO-NPS or the number of airmen high school graduates for SMSO-BCP and/or SMSO-AECP, could potentially reduce the program costs; however, in either event the reduction cost would be less than one percent, probably not signigicant.

On the other hand, modifications in procurement policy could have significant impact. For example, there is a limit on annual recruitment by SMSO-BCP and SMSO-AECP combined of 600. Allowing this to increase three-fold, that is to 1800, could result in a procurement cost savings of more than 11 percent, or $548.9 million. Alternatively, by reducing the Air Force Academy entering class size from 900 to 500 annually, more than $205 million could be saved.

Finally, Table 8 shows that costs could be reduced if we did not impose constraints to insure quality distribution. Selective production constraints were included in the modified system for illustrative purposes. The distribution of the procurement of different type officers among the various commissioning sources influences the total procurement costs. In the modified case, selective production constraints were added to insure all sources provide non-rated officers. Eliminating this requirement could save approximately $145 million.

4. Sensitivity of Cost Coefficients. Several observations can be made concerning the cost coefficients sensitivity (see REDCST or PRIMAL)[4]

First, there are alternate optimal procurement plans. Navigators can be procured through SMSO-NPS and/or USAFA rather than AFROTC to meet requirements in all years except 1971.

Second, assuming that the decision criteria used in planning procurement is based solely on cost, approximately one-third of the 75

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[4] RANGE output in Appendix B .

TOPOPS decisions[5] are highly dependent upon the cost factors for this hypothetical sample problem. Specifically, any changes in the procurement costs of navigators or pilots procured through SMSO-NPS and AFROTC will result in a different solution; any changes in the cost of USAFA will cause shifting the distribution of its rated and non-rated officer procurement. On the other hand, decreasing the cost of SMSO-BCP and SMSO-AECP will not affect the optimal solution since these are already the lowest cost agencies and there is a ceiling restricting their procurement. By the same token, raising the USAFA cost will not affect its overall procurement level, since a minimum requirement has been imposed. En toto, more than 40 percent of the TOPOPS decisions reflect significant insensitivity to the prevailing costs. Generally, this results from the overriding effects of system constraints.

D. Quality Sensitivity

To do a similar analysis in terms of quality maximization is difficult because the TOPOPS quality concept is multi-faceted. Such analysis in terms of the quality objective function is somewhat inconclusive as well because the range over which AFOQT scores, the quality measure, may vary is not particularly discriminating.

For example, as in the cost analysis, the TOPOPS model was run for a "free" system and for the existing system. Maximizing the average AFOQT score exclusive of any operating constraints yields an average score of 73. Introducing constraints such as limiting the Air Force Academy and AFROTC procurement results in the average score being reduced to 70. There is probably a significant difference between scores of 70 and 50; however, a three point spread does not really seem significant.

Table 9 shows the distribution of officers by commissioning source to meet procurement requirements under TOPOPS quality maximization. The procurement pattern is similar to that obtained when minimizing cost with one exception. Rather than SMSO-NPS being the primary source, procurement is more evenly distributed between AFROTC and SMSO-NPS. This occurs under quality maximization because TOPOPS

[5] 75 = 3 officer types x 5 sources x 5 years

attempts to exhaust all high-AFOQT supply pools first. AFROTC has a larger high-AFOQT supply than SMSO-NPS based upon the hypothetical data used. If AFROTC could procure non-rated officers, it would have become the primary source of officers. AFROTC procures only rated qualified officers in this sample problem. Due to the training agency crossflows and implied attrition rates, however, some commissioned officers from AFROTC enter an active duty assignment as non-rated. As was previously noted (refer to Table 5, TOPOPS Cost Factors), these sources produce officers at similar costs; hence, the substitution from SMSO-NPS to AFROTC occurs without significant cost differences.

Appendix C contains the TOPOPS output for quality maximization given the modified system. The most interesting and useful insight provided by these data relates to the program costs. Consider that:

1. when TOPOPS maximized average AFOQT score given a "free" system, i.e., only supply and demand constraints, the five year program cost was $7.1 billion

2. costs were reduced to $5.0 billion when operating constraints (reflecting the modified system) were added with no significant affect on the average AFOQT score

3. the program costs under TOPOPS cost minimization or quality maximization are approximately the same ($4.9 billion versus $5.0 billion) or, in other words, modified system constraints are effectively binding regardless of the TOPOPS mode.

Significant reductions in the cost of procurement may be possible without concomitant reductions in average AFOQT score. The basis for exploiting this potential is the cost analysis previously discussed and further experimentation using the TOPOPS model in a cost minimization mode. Apparently, given the non-discriminating nature of the hypothetical AFOQT data, TOPOPS can be most effectively used as a cost optimization model and still allow for consideration of force quality.

Table 6

OFFICERS BY COMMISSIONING SOURCE

Baseline Case - Cost Minimization

	1970	1971	1972	1973	1974	Total
Pilot						
SMSO-NPS	0.	0.	0.	0.	67.	67.
SMSO-AECP	0.	0.	0.	3579.	980.	4559.
SMSO-BCP	5589.	4811.	4085.	0.	1310.	15795.
AFROTC	0.	0.	0.	0.	1040.	1040.
USAFA	0.	0.	0.	0.	0.	0.
Navigator						
SMSO-NPS	0.	0.	133.	212.	4.	349.
SMSO-AECP	0.	0.	0.	199.	54.	253.
SMSO-BCP	867.	1149.	1176.	0.	73.	3264.
AFROTC	0.	0.	0.	766.	1309.	2075.
USAFA	0.	0.	0.	0.	0.	0.
Non-rated						
SMSO-NPS	1049.	2822.	2518.	2945.	977.	10310.
SMSO-AECP	0.	0.	0.	199.	54.	253.
SMSO-BCP	3246.	385.	353.	0.	1382.	5366.
AFROTC	0.	0.	0.	102. *	225. *	327. *
USAFA	0.	0.	0.	0.	0.	0.
Total						
SMSO-NPS	1049.	2822.	2651.	3157.	1048.	10727.
SMSO-AECP	0.	0.	0.	3977.	1088.	5065.
SMSO-BCP	9702.	6345.	5614.	0.	2765.	24426.
SMSO-AFROTC	0.	0.	0.	868.	2574.	3442.
USAFA	0.	0.	0.	0.	0.	0.
TOTAL	10751.	9167.	8265.	8002.	7475.	43660.

*These numbers occur because of the attrition factor inherent within the training stage of the procurement process.

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Table 7

OFFICERS BY COMMISSIONING SOURCE

Modified System - Cost Minimization

	1970	1971	1972	1973	1974	TOTAL
Pilot						
SMSO-NPS	4091.	1646.	3375.	2240.	2171.	13523.
SMSO-AECP	267.	189.	211.	217.	31.	915.
SMSO-BCP	262.	184.	205.	37.	204.	892.
AFROTC	418.	2319.	90.	905.	821.	4553.
USAFA	551.	473.	204.	179.	170.	1576.
Navigator						
SMSO-NPS	607.	438.	187.	124.	121.	1477.
SMSO-AECP	15.	11.	12.	12.	2.	51.
SMSO-BCP	15.	10.	11.	2.	11.	50.
AFROTC	200.	664.	1087.	760.	1297.	4009.
USAFA	31.	26.	11.	278.	9.	356.
Non-rated						
SMSO-NPS	3954.	2500.	2537.	2544.	1501.	13036.
SMSO-AECP	93.	67.	62.	70.	91.	383.
SMSO-BCP	93.	67.	61.	60.	273.	554.
AFROTC	47. *	200. *	149. *	145. *	212. *	754. *
USAFA	109.	373.	61.	427.	560.	1530.
Total						
SMSO-NPS	8652.	4584.	6099.	4908.	3793.	28036.
SMSO-AECP	375.	267.	285.	299.	124.	1349.
SMSO-BCP	370.	261.	277.	99.	488.	1496.
AFROTC	665.	3183.	1326.	1810.	2330.	9616.
USAFA	691.	872.	276.	884.	739.	3462.
TOTAL	10753.	9167.	8263.	8000.	7474.	43959.

*See footnote on Table 6

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Table 8

Binding System Constraints

Supply	Estimated (millions)	Cost Savings percent of total
Availability of College Graduates	$ 43.2	0.9
Availability of Airmen High School Graduates	16.0	0.3
Limitation of SMSO-AECP and SMSO-BCP Programs	548.9	11.2
Minimum USAFA Procurement	205.9	4.2
Quality Distribution (Selective Production)	145.0	3.0
Total Five-Year Program Cost Saving	$959.0	19.6

Table 9

OFFICERS BY COMMISSIONING SOURCE

Modified System - Quality Maximization

	1970	1971	1972	1973	1974	TOTAL
Pilot						
SMSO	1390.	2052.	1552.	1107.	0.	6101.
SMSO-AECP	230.	267.	0.	267.	0.	764.
SMSO-BCP	262.	184.	252.	0.	0.	698.
AFROTC	3150.	2205.	1851.	2205.	2961.	12372.
USAFA	557.	104.	428.	0.	435.	1524.
Navigator						
SMSO	629.	209.	87.	253.	1251.	2429.
SMSO-AECP	13.	15.	0.	15.	0.	43.
SMSO-BCP	15.	10.	14.	0.	0.	39.
AFROTC	175.	911.	1185.	911.	165.	3347.
USAFA	31.	6.	24.	0.	24.	85.
Non-rated						
SMSO	3529.	2543.	1943.	2531.	1369.	11915.
SMSO-AECP	13.	282.	0.	105.	267.	667.
SMSO-BCP	94.	20.	101.	262.	262.	739.
AFROTC	175. *	228. *	250. *	228. *	165. *	1046. *
USAFA	485.	135.	581.	121.	575.	1897.
Total						
SMSO	5548.	4804.	3582.	3891.	2620.	20445.
SMSO-AECP	256.	564.	0.	387.	267.	1474.
SMSO-BCP	371.	214.	367.	262.	262.	1476.
AFROTC	3500.	3344.	3286.	3344.	3291.	16765.
USAFA	1073.	255.	1033.	121.	1034.	3506.
TOTAL	10748.	9181.	8268.	8005.	7474.	43666.

*See footnote in Table 6

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Appendix A

Data Initializer Output

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@REWIND 9.

@BRKPT PUNCH8/11

@XQT TOPOPS.DATPREP
 INITAL NEXT
 DATAIN NEXT

@ADD,P TOPOPS.AKMAN
  BASE YEAR 1970  OFFICER TYPE  1  DESCRIP PILOT
 PROCUREMENT REQ     5589   4811   4085   3579   3396
  BASE YEAR 1970  OFFICER TYPE  2  DESCRIP NAVIGATOR
 PROCUREMENT REQ      867   1149   1309   1177   1440
  BASE YEAR 1970  OFFICER TYPE  3  DESCRIP NONRATED
 PROCUREMENT REQ     4295   3207   2871   3246   2638
  THE OBJECTIVE IS TO OPTIMIZE COST
  AGENCY   0  BASE YEAR  1970   AGENCY DESCRIP SMSO-MALE
  P AND A COSTS   4540 OTHER COSTS       0 PROGRAM LENGTH  1
  OFFICER TYPE 1 IS PRODUCED BY AGENCY  0 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
  AGENCY CROSSFLOW RATE IS   .850   .000   .000   .000   .000
  OFFICER TYPE 2 IS PRODUCED BY AGENCY  0 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
  AGENCY CROSSFLOW RATE IS   .000   .850   .000   .000   .000
  OFFICER TYPE 3 IS PRODUCED BY AGENCY  0 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
  AGENCY CROSSFLOW RATE IS   .000   .000   .850   .000   .000
  AGENCY 0 MIN PROD LIMIT   1000  1000  1000  1000  1000 FOR YEARS 0 THRU  4
  AGENCY 0 MIN PROD LIMIT   1000  1000  1000  1000  1000 FOR YEARS 5 THRU  9
  AGENCY   1  BASE YEAR  1970   AGENCY DESCRIP AECP
  P AND A COSTS  23000 OTHER COSTS       0 PROGRAM LENGTH  3
  OFFICER TYPE 1 IS PRODUCED BY AGENCY  1 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  1.0
  AGENCY CROSSFLOW RATE IS   .990   .000   .000   .000   .000
  OFFICER TYPE 2 IS PRODUCED BY AGENCY  1 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  1.0
  AGENCY CROSSFLOW RATE IS   .000   .990   .000   .000   .000
  OFFICER TYPE 3 IS PRODUCED BY AGENCY  1 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  1.0
  AGENCY CROSSFLOW RATE IS   .000   .000   .990   .000   .000
  AGENCY 1 MAX PROD LIMIT    300   300   300   300   300 FOR YEARS 0 THRU  4
  AGENCY 1 MAX PROD LIMIT    300   300   300   300   300 FOR YEARS 5 THRU  9
  AGENCY 1 MIN PROD LIMIT    100   100   100   100   100 FOR YEARS 0 THRU  4
  AGENCY 1 MIN PROD LIMIT    100   100   100   100   100 FOR YEARS 5 THRU  9
  AGENCY   2  BASE YEAR  1970   AGENCY DESCRIP BCP
  P AND A COSTS  10370 OTHER COSTS       0 PROGRAM LENGTH  2
  OFFICER TYPE 1 IS PRODUCED BY AGENCY  2 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  1.0
  AGENCY CROSSFLOW RATE IS   .970   .000   .000   .000   .000
  OFFICER TYPE 2 IS PRODUCED BY AGENCY  2 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  1.0
  AGENCY CROSSFLOW RATE IS   .000   .970   .000   .000   .000
  OFFICER TYPE 3 IS PRODUCED BY AGENCY  2 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  1.0
  AGENCY CROSSFLOW RATE IS   .000   .000   .970   .000   .000
  AGENCY 2 MAX PROD LIMIT    300   300   300   300   300 FOR YEARS 0 THRU  4
  AGENCY 2 MAX PROD LIMIT    300   300   300   300   300 FOR YEARS 5 THRU  9
  AGENCY 2 MIN PROD LIMIT    100   100   100   100   100 FOR YEARS 0 THRU  4
  AGENCY 2 MIN PROD LIMIT    100   100   100   100   100 FOR YEARS 5 THRU  9
  AGENCY   3  BASE YEAR  1970   AGENCY DESCRIP AFROTC
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P AND A COSTS   9250 OTHER COSTS       0 PROGRAM LENGTH  3
OFFICER TYPE 1 IS PRODUCED BY AGENCY  3 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
AGENCY CROSSFLOW RATE IS   .700   .000   .000   .000   .000
OFFICER TYPE 2 IS PRODUCED BY AGENCY  3 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
AGENCY CROSSFLOW RATE IS   .000   .700   .000   .000   .000
AGENCY 3 MIN PROD LIMIT   1000  1000  1000  1000  1000 FOR YEARS 0 THRU  4
AGENCY 3 MIN PROD LIMIT   1000  1000  1000  1000  1000 FOR YEARS 5 THRU  9
AGENCY 3 MAX PROD LIMIT   5000  5000  5000  5000  5000 FOR YEARS 0 THRU  4
AGENCY 3 MAX PROD LIMIT   5000  5000  5000  5000  5000 FOR YEARS 5 THRU  9
AGENCY   4  BASE YEAR  1970   AGENCY DESCRIP AIR FORCE ACADEMY
P AND A COSTS  66890 OTHER COSTS       0 PROGRAM LENGTH  4
OFFICER TYPE 1 IS PRODUCED BY AGENCY  4 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
AGENCY CROSSFLOW RATE IS   .680   .000   .000   .000   .000
OFFICER TYPE 2 IS PRODUCED BY AGENCY  4 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
AGENCY CROSSFLOW RATE IS   .000   .680   .000   .000   .000
OFFICER TYPE 3 IS PRODUCED BY AGENCY  4 AGENCY TURNOVER RATE FOR THIS OFFICER TYPE IS  2.0
AGENCY CROSSFLOW RATE IS   .000   .000   .680   .000   .000
AGENCY 4 MIN PROD LIMIT    900   900   900   900 .  900 FOR YEARS 0 THRU  4
AGENCY 4 MIN PROD LIMIT    900   900   900   900   900 FOR YEARS 5 THRU  9
AGENCY 4 MAX PROD LIMIT    910   910   910   910   910 FOR YEARS 0 THRU  4
AGENCY 4 MAX PROD LIMIT    910   910   910   910   910 FOR YEARS 5 THRU  9
SUPPLY POOL   1  POOL DESCR ELIG COLL GRAD-LOW AFOQT   50
 OFF FROM POOL     1    1    1    0    0  BASE YEAR   1970
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 0 IS  4810
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 1 IS  4810
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 2 IS  4810
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 3 IS  4810
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 4 IS  4810
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 5 IS  4810
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 6 IS  4200
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 7 IS  4050
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 8 IS  3000
SUPPLY POOL  1 QUANTITY AVAILABLE FOR YEAR 9 IS  4300
SUPPLY POOL  1 SUPPLIES AGENCIES-      0   0   0   0   0   0   0   0   0   1
SUPPLY POOL   2  POOL DESCR ELIG COLL GRAD-MED AFOQT   70
 OFF FROM POOL     1    1    1    0    0  BASE YEAR   1970
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 0 IS  2152
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 1 IS  2152
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 2 IS  2152
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 2 IS  2152
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 4 IS  2152
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 5 IS  2152
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 6 IS  1440
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 7 IS  1560
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 8 IS  1200
SUPPLY POOL  2 QUANTITY AVAILABLE FOR YEAR 9 IS   560
SUPPLY POOL  2 SUPPLIES AGENCIES-      0   0   0   0   0   0   0   0   0   1
SUPPLY POOL   3  POOL DESCR ELIG COLL GRAD-HI  AFOQT   90
 OFF FROM POOL     1    1    1    0    0  BASE YEAR   1970
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 0 IS   538
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 1 IS   538
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 2 IS   538
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 3 IS   538
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 4 IS   538
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 5 IS   538
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 6 IS   360
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 7 IS   390
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SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 8 IS   300
SUPPLY POOL  3 QUANTITY AVAILABLE FOR YEAR 9 IS   140
SUPPLY POOL  3 SUPPLIES AGENCIES-     0   0   0   0   0   0   0   0   0   1
SUPPLY POOL   6  POOL DESCR ELIG HS GRAD-HI    AFOQT   90
 OFF FROM POOL     1   1   1   0   0  BASE YEAR   1970
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 0 IS  1000
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 1 IS  1000
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 2 IS  1000
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 3 IS  1000
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 4 IS  1000
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 5 IS   110
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 6 IS   150
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 7 IS   150
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 8 IS   150
SUPPLY POOL  6 QUANTITY AVAILABLE FOR YEAR 9 IS   150
SUPPLY POOL  6 SUPPLIES AGENCIES-     1   1   0   1   0   0   0   0   0   0
SUPPLY POOL   5  POOL DESCR ELIG HS GRAD - MED AFOQT   70
 OFF FROM POOL     1   1   1   0   0  BASE YEAR   1970
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 0 IS  4000
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 1 IS  4000
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 2 IS  4000
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 3 IS  4000
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 4 IS  4000
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 5 IS   448
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 6 IS   600
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 7 IS   600
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 8 IS   600
SUPPLY POOL  5 QUANTITY AVAILABLE FOR YEAR 9 IS   600
SUPPLY POOL  5 SUPPLIES AGENCIES-     1   1   0   1   0   0   0   0   0   0
SUPPLY POOL   4  POOL DESCR ELIG HS GRAD - LOW AFOQT   50
 OFF FROM POOL     1   1   1   0   0  BASE YEAR   1970
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 0 IS  5000
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 1 IS  5000
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 2 IS  5000
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 3 IS  5000
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 4 IS  5000
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 5 IS   550
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 6 IS   750
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 7 IS   750
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 8 IS   750
SUPPLY POOL  4 QUANTITY AVAILABLE FOR YEAR 9 IS   750
SUPPLY POOL  4 SUPPLIES AGENCIES-     1   1   0   1   0   0   0   0   0   0
SUPPLY POOL   7  POOL DESCR ELIGIBLE ROTC-LOW  AFOQT   50
 OFF FROM POOL     1   1   0   0   0  BASE YEAR   1970
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 0 IS  7500
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 1 IS  7500
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 2 IS  7500
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 3 IS  7500
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 4 IS  7500
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 5 IS  2350
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 6 IS  2100
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 7 IS  1900
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 8 IS  2000
SUPPLY POOL  7 QUANTITY AVAILABLE FOR YEAR 9 IS  2000
SUPPLY POOL  7 SUPPLIES AGENCIES-     0   0   1   0   0   0   0   0   0   0
SUPPLY POOL   8  POOL DESCR ELIGIBLE ROTC-MED  AFOQT   70
 OFF FROM POOL     1   1   0   0   0  BASE YEAR   1970
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```
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 0 IS  6000
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 1 IS  6000
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 2 IS  6000
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 3 IS  6000
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 4 IS  6000
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 5 IS  1880
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 6 IS  1480
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 7 IS  1520
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 8 IS  1400
SUPPLY POOL  8 QUANTITY AVAILABLE FOR YEAR 9 IS  1400
SUPPLY POOL  8 SUPPLIES AGENCIES-     0   0   1   0   0   0   0   0   0   0
SUPPLY POOL   9  POOL DESCR ELIGIBLE ROTC-HI   AFOQT   90
 OFF FROM POOL     1    1    0    0    0  BASE YEAR   1970
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 0 IS  1500
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 1 IS  1500
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 2 IS  1500
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 3 IS  1500
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 4 IS  1500
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 5 IS   470
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 6 IS   420
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 7 IS   380
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 8 IS   400
SUPPLY POOL  9 QUANTITY AVAILABLE FOR YEAR 9 IS   400
SUPPLY POOL  9 SUPPLIES AGENCIES-     0   0   1   0   0   0   0   0   0   0
TRAINING DESCRIPTOR IS UPT                FOR SCHOOL 1 COST PER GRADUATE IS  86000 SCHOOL LENGTH IS  1 YEARS
SCHOOL CROSSFLOW IS  .900  .000  .000  .000  .000   BASE YEAR IS 1970
TRAINING DESCRIPTOR IS UNT                FOR SCHOOL 2 COST PER GRADUATE IS  20000 SCHOOL LENGTH IS  1 YEARS
SCHOOL CROSSFLOW IS  .050  .750  .000  .000  .000   BASE YEAR IS 1970
TRAINING DESCRIPTOR IS TECH SCHOOL        FOR SCHOOL 3 COST PER GRADUATE IS   5000 SCHOOL LENGTH IS  0 YEARS
SCHOOL CROSSFLOW IS  .050  .100  .900  .000  .000   BASE YEAR IS 1970
 OFF   3   AGCY    1  BASE YEAR  1970
SEL PROD      .02      .02      .02      .02      .02
 OFF   3   AGCY    4  BASE YEAR  1970
SEL PROD      .02      .02      .02      .02      .02
 OFF   3   AGCY    2  BASE YEAR  1970
SEL PROD      .02      .02      .02      .02      .02
 OFF   1   AGCY    4  BASE YEAR  1970
SEL PROD      .05      .05      .05      .05      .05
INFLATION RATE IS  .000
REQUIREMENT YEAR 5          PROGRAM BUDGET (IN THOUSANDS)  1300000.
REQUIREMENT YEAR 6          PROGRAM BUDGET (IN THOUSANDS)  1030000.
REQUIREMENT YEAR 7          PROGRAM BUDGET (IN THOUSANDS)  1030000.
REQUIREMENT YEAR 8          PROGRAM BUDGET (IN THOUSANDS)  1000000.
REQUIREMENT YEAR 9          PROGRAM BUDGET (IN THOUSANDS)  1000000.
```

FORM NUMBER	RECORD TYPE 1	2	3	4	5	TOTAL CARDS	BASE YEAR
1	3	1	1	5	0	10	1970
2	5	14	10	8	0	37	1970
3	9	90	9	0	0	108	1970
4	3	0	0	0	0	3	1970
5	4	0	0	0	0	4	1970

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Appendix B

TOPOPS Report Generator Output of Modified Baseline Case - Cost Minimization

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AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
ANNUAL PROCUREMENT SCHEDULE

DATE OF REPORT: 10 SEPT 1973 OBJECTIVE: MINIMIZE COST

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
PROCUREMENT REQUIREMENTS										
PILOT						5589	4811	4885	3579	3396
NAVIGATOR						867	1149	1389	1177	1448
NONRATED						4296	3207	2871	3246	2638
TOTAL						10751.	9167.	8265.	8002.	7474.
TRAINING REQUIREMENTS										
PILOT	0.	0.	0.	0.	6210.	5346.	4539.	3977.	3773.	0.
NAVIGATOR	0.	0.	0.	0.	742.	1176.	1443.	1304.	1668.	0.
NONRATED	0.	0.	0.	0.	0.	4345.	3136.	2778.	3241.	2536.
TOTAL	0.	0.	0.	0.	6952.	10866.	9117.	8058.	8683.	2536.
RECRUITMENT REQUIREMENTS										
SMSO-MALE										
PILOT	0.	0.	0.	5348.	2152.	4811.	2928.	2838.	0.	
NAVIGATOR	0.	0.	0.	596.	543.	0.	0.	0.	0.	
NONRATED	0.	0.	0.	0.	4805.	3889.	3872.	3162.	1805.	
AECP										
PILOT	0.	300.	212.	237.	244.	35.	0.	0.	0.	
NAVIGATOR	0.	0.	0.	0.	0.	0.	0.	0.	0.	
NONRATED	0.	0.	88.	63.	56.	65.	100.	0.	0.	
BCP										
PILOT	0.	0.	300.	210.	235.	43.	233.	0.	0.	
NAVIGATOR	0.	0.	0.	0.	0.	0.	0.	0.	0.	
NONRATED	0.	0.	0.	90.	65.	57.	67.	300.	0.	
AFROTC										
PILOT	0.	663.	3682.	143.	1437.	1303.	0.	0.	0.	
NAVIGATOR	0.	337.	1020.	2041.	1352.	2284.	0.	0.	0.	
NONRATED	0.	0.	0.	0.	0.	0.	0.	0.	0.	
AIR FORCE ACADEMY										
PILOT	900.	772.	334.	292.	277.	0.	0.	0.	0.	

AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
ANNUAL PROCUREMENT SCHEDULE

DATE OF REPORT: 10 SEPT 1973

OBJECTIVE: MINIMIZE COST

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
RECRUITMENT REQUIREMENTS (CONTINUED)										
AIR FORCE ACADEMY										
NAVIGATOR	0.	0.	0.	526.	0.	0.	0.	0.	0.	
NONRATED	0.	128.	566.	82.	623.	900.	0.	0.	0.	
TOTAL										
PILOT	900.	1736.	4528.	6230.	4346.	5792.	3161.	2838.	0.	
NAVIGATOR	0.	337.	1020.	3183.	1896.	2384.	0.	0.	0.	
NONRATED	0.	128.	654.	236.	5648.	4111.	3239.	3462.	1805.	

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AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
AGGREGATE COST ESTIMATES
(IN MILLIONS)

DATE OF REPORT: 10 SEPT 1973

OBJECTIVE: MINIMIZE COST

PROGRAM COSTS	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	425.2	185.1	335.5	231.4	214.5	1391.8
AECP	32.6	23.1	25.3	26.3	6.2	113.5
BCP	27.2	19.1	21.1	4.7	24.5	96.6
AFROTC	46.6	244.2	44.5	111.9	121.5	568.7
AIR FORCE ACADEMY	95.3	103.9	37.0	88.6	71.1	396.0
TOTAL	626.9	575.4	463.5	462.8	437.8	2566.5

PROGRAM COSTS (WITH TURNOVER)	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	850.4	370.3	671.1	462.7	429.0	2783.6
AECP	32.6	23.1	25.3	26.3	6.2	113.5
BCP	27.2	19.1	21.1	4.7	24.5	96.6
AFROTC	93.3	488.4	89.0	223.7	243.0	1137.3
AIR FORCE ACADEMY	190.5	207.8	74.0	177.2	142.3	791.9
TOTAL	1194.1	1108.7	880.5	894.6	845.0	4922.9

AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
COST ANALYSIS

DATE OF REPORT: 10 SEPT 1973

OBJECTIVE: MINIMIZE COST

I. COST PER OFFICER

	PAY AND ALLOWANCES	OTHER COSTS	TOTAL COSTS
SMSO-MALE	4540	0	4540
AECP	23000	0	23000
BCP	10370	0	10370
AFROTC	9250	0	9250
AIR FORCE ACADEMY	66890	0	66890
AVERAGE	11270.	0.	11270.

II. COST PERCENTAGES

	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	67.8	32.2	72.9	50.0	49.0	54.2
AECP	5.2	9.0	5.5	5.7	1.9	4.9
BCP	4.3	3.3	9.4	1.0	5.6	3.8
AFROTC	7.9	42.9	9.6	24.2	27.7	22.2
AIR FORCE ACADEMY	15.2	18.1	8.0	19.1	16.3	15.9
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

III. COST PERCENTAGES (WITH TURNOVER)

	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	71.2	33.4	76.2	51.7	50.8	56.5
AECP	2.7	2.1	2.9	2.9	.7	2.3
BCP	2.3	1.7	2.4	.5	2.9	2.0
AFROTC	7.8	44.1	10.1	25.0	28.8	23.1
AIR FORCE ACADEMY	16.0	18.7	8.4	19.8	16.8	14.1
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

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AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
OFFICER QUALITY PROFILE

DATE OF REPORT: 10 SEPT 1973

OBJECTIVE: MINIMIZE COST

I. AVERAGE QUALITY

	1970	1971	1972	1973	1974	AVERAGE
SMSO-MALE	58.	57.	59.	62.	53.	57.
AECP	50.	50.	50.	70.	50.	54.
BCP	50.	50.	50.	60.	70.	57.
AFROTC	50.	50.	50.	50.	57.	52.
AIR FORCE ACADEMY	50.	50.	50.	61.	40.	55.
AVERAGE	54.	53.	56.	59.	56.	56.

II. SOURCE OF SUPPLY (1970-74)

	SMSO-MALE	AECP	BCP	AFROTC	AIR FORCE ACADEMY						TOTAL
ELIG COLL GRAD-LOW	24485.	0.	0.	0.	0.	0.	0.	0.	0.	0.	24485.
ELIG COLL GRAD-MED	7900.	0.	0.	0.	0.	0.	0.	0.	0.	0.	7900.
ELIG COLL GRAD-HI	2364.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2364.
ELIG HS GRAD - LOW	0.	1091.	1067.	0.	4097.	0.	0.	0.	0.	0.	6255.
ELIG HS GRAD - MED	0.	309.	533.	0.	1193.	0.	0.	0.	0.	0.	2035.
ELIG HS GRAD-HI	0.	0.	0.	0.	110.	0.	0.	0.	0.	0.	110.
ELIGIBLE ROTC-LOW	0.	0.	0.	13045.	0.	0.	0.	0.	0.	0.	13045.
ELIGIBLE ROTC-MED	0.	0.	0.	1337.	0.	0.	0.	0.	0.	0.	1337.
ELIGIBLE ROTC-HI	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

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AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
OFFICER QUALITY PROFILE

DATE OF REPORT: 10 SEPT 1973

OBJECTIVE: MINIMIZE COST

III. OFFICERS BY PRODUCTION AGENCY

	1970	1971	1972	1973	1974	TOTAL
PILOT						
SMSO-MALE	4091.	1496.	3375.	2240.	2171.	13523.
AECP	247.	189.	211.	217.	31.	915.
BCP	242.	184.	205.	37.	204.	892.
AFROTC	418.	2319.	90.	905.	821.	4553.
AIR FORCE ACADEMY	551.	473.	204.	179.	170.	1576.
NAVIGATOR						
SMSO-MALE	407.	438.	187.	124.	121.	1477.
AECP	15.	11.	12.	12.	2.	51.
BCP	15.	10.	11.	2.	11.	50.
AFROTC	200.	664.	1087.	740.	1297.	4009.
AIR FORCE ACADEMY	31.	26.	11.	278.	9.	356.
NONRATED						
SMSO-MALE	3954.	2500.	2537.	2644.	1501.	13036.
AECP	93.	67.	62.	70.	91.	383.
BCP	93.	67.	61.	60.	273.	554.
AFROTC	47.	200.	149.	145.	212.	754.
AIR FORCE ACADEMY	109.	373.	61.	427.	560.	1530.

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AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
PROCUREMENT POLICY ANALYSIS

DATE OF REPORT: 10 SEPT 1973

OBJECTIVE: MINIMIZE COST

CONSTRAINT	MARGINAL IMPROVEMENT	RANGE		
D301	.00	4533.	TO	5356.
D303	.00	261.	TO	1084.
D401	8.01	4584.	TO	5650.
D402	8.01	1986.	TO	5184.
D403	8.01	292.	TO	1378.
D501	8.01	3889.	TO	4927.
D502	8.01	0.	TO	2269.
D503	8.01	0.	TO	655.
D601	8.01	3072.	TO	5383.
D602	8.01	0.	TO	2623.
D603	8.01	8.	TO	1543.
D504	84.18	550.	TO	750.
D505	84.18	488.	TO	698.
D506	84.18	110.	TO	310.
D701	8.01	3603.	TO	5123.
D702	8.01	1113.	TO	2633.
D703	8.01	0.	TO	1463.
D507	.00	1807.	TO	3687.
F13	6.59	1723.	TO	-463.
F04	84.80	-910.	TO	-553.
F14	78.39	-910.	TO	-593.
F24	78.39	-910.	TO	-426.
F34	78.39	-910.	TO	-374.
F51	10.77	-100.	TO	-65.
F44	78.39	-910.	TO	-373.
F61	9.33	-300.	TO	-51.
F54	168.97	-980.	TO	-700.
G11	64.08	100.	TO	749.
G22	75.04	180.	TO	779.
G21	73.41	100.	TO	2903.
G32	84.18	100.	TO	2957.
G31	73.41	100.	TO	401.
G42	84.18	180.	TO	403.
G41	73.41	100.	TO	1316.
G62	84.18	180.	TO	667.
G72	3.11	180.	TO	400.
H531	74.15	-297.	TO	0.
H532	74.15	-291.	TO	0.
H534	.00	-395.	TO	0.

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AIR FORCE HUMAN RESOURCE LABORATORY

TOPOPS OFFICER PROCUREMENT
PROCUREMENT POLICY ANALYSIS

DATE OF REPORT: 10 SEPT 1973

OBJECTIVE: MINIMIZE COST

CONSTRAINT	MARGINAL IMPROVEMENT	RANGE		
M631	74.15	-297.	TO	0.
M632	74.15	-291.	TO	0.
M714	.00	-509.	TO	0.
M731	74.15	-297.	TO	0.
M732	74.15	-97.	TO	0.
M734	.00	-918.	TO	8.
M814	.00	-556.	TO	0.
M831	74.15	-99.	TO	0.
M832	74.15	-291.	TO	0.
M914	.00	-607.	TO	0.

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PRIMAL OUTPUT

CASE ITERATION 184 OBJECTIVE VALUE -4922878.0

LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY
E COST	.000000	-.4922878+07	103	.000000	3800.000061	D105	.000000	4000.000000
D106	.000000	1000.000000	204	.000000	3500.000092	D205	.000000	4000.000000
D206	.000000	1000.000000	D100	.000000	6500.000000	D108	.000000	6000.000000
D109	.000000	1500.000000	D 4	.000000	4100.000000	D 5	.000000	4000.000000
D 6	.000000	1000.000000	D304	.000000	4318.307312	D305	.000000	3181.692871
D306	.000000	1000.000000	D207	.000000	2798.307556	D208	.000000	6000.000000
D209	.000000	1500.000000	D404	.000000	3743.888336	D405	.000000	3756.111786
D406	.000000	1000.000000	D307	.000000	5296.358643	D308	.000000	6000.000000
D309	.000000	1500.000000	D407	.000000	4710.582458	D408	.000000	6000.000000
D409	.000000	1500.000000	D604	.000000	583.180672	D605	.000000	366.819328
D606	.000000	150.000000	D508	.000000	543.170341	D509	.000000	470.000000
D801	.000000	1195.136368	D802	.000000	1200.000000	D803	.000000	300.000000
D704	.000000	750.000000	D705	.000000	300.000000	D706	.000000	150.000000
F30	.000000	4943.690613	F11	.000000	200.000000	F22	.000000	200.000000
F40	.000000	6500.000000	F21	.000000	200.000002	F32	.000000	200.000002
F23	.000000	3701.692474	F50	.000000	6500.000000	F31	.000000	200.000002
F42	.000000	200.000002	F33	.000000	1203.641403	F60	.000000	5000.000000
F41	.000000	200.000002	F52	.000000	.000000	F43	.000000	1789.417511
F70	.000000	5000.000000	F62	.000000	200.000000	F53	.000000	2686.829681
F80	.000000	809.863633	F72	.000000	200.000000	G13	.000000	4000.000000
G 4	.000000	10.000000	G14	.000000	10.000000	G23	.000000	298.307541
G24	.000000	10.000000	G33	.000000	2796.358643	G52	.000000	200.000004
G34	.000000	10.000000	G43	.000000	2210.582489	G51	.000000	200.000000
G44	.000000	10.000000	G53	.000000	1313.170368	G61	.000000	200.000000
G54	.000000	10.000000	H514	.000000	301.495102	H614	.000000	257.821709
H634	.000000	322.336105	H834	.000000	358.511909	H931	.000000	98.278100
H932	.000000	240.285860	H934	.000000	561.273109	610	-166.379999	4545.686401
51001	.000000	4810.000000	51003	.000000	538.000000	511	-101.650000	297.000298
51104	.000000	300.000000	512	-89.020000	291.007858	51204	.000000	300.000000
513	-175.799999	464.310394	51307	.000000	663.313843	514	-291.079998	611.995102
51404	.000000	900.000000	520	-40.080000	506.324402	52002	.000000	595.690651
52104	.000000	.000000	52204	.000000	.000000	523	-49.500000	235.675598
52307	.000000	336.686157	52404	.000000	.000000	530	-18.080000	4084.091064
53001	.000000	4266.933105	53003	.000000	538.000000	531	-27.500000	86.895599
53104	.000000	87.773244	532	-14.870000	86.895599	53204	.000000	89.580671
534	-142.779999	86.895599	53404	.000000	127.788668	610	-166.379999	1829.154358
61002	.000000	2152.000000	611	-101.650000	210.104700	61104	.000000	212.226757
612	-89.020000	204.112263	61204	.000000	210.419331	613	-175.799999	2577.084717
61307	.000000	3681.623199	614	-291.079998	525.099503	61404	.000000	772.211334
620	-40.080000	461.595367	62001	.000000	543.066925	621	-38.500000	.000000
62204	.000000	.000000	623	-49.500000	714.034233	62307	.000000	1020.069298
624	-164.779999	.000000	630	-18.080000	2625.252598	63001	.000000	3088.609650
631	-27.500000	62.714600	63104	.000000	63.348018	632	-14.870000	62.714600
63204	.000000	64.652479	634	-142.779999	385.050708	63404	.000000	566.255569
710	-166.379999	3749.888135	71001	.000000	1721.390381	71002	.000000	2152.000000

11 SEP 73 TOPOPS OFFICER PROCUREMENT MODEL .001.005.002

LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY
71003	.000000	538.000000	711	-101.650000	234.285700	71104	.000000	236.651985
712	-89.020000	228.293262	71204	.000000	235.347523	713	-175.799999	99.777461
71307	.000000	142.542080	714	-291.079998	226.944399	71404	.000000	333.749931
72002	.000000	.000000	72104	.000000	.000000	72204	.000000	.000000
723	-49.500000	1442.740692	72307	.000000	2061.099335	72404	.000000	.000000
730	-18.080000	2410.882904	73001	.000000	3071.703705	731	-27.500000	55.550700
73104	.000000	54.111741	732	-14.870000	55.550700	73204	.000000	57.247215
734	-142.779999	55.550700	73404	.000000	81.692858	810	-166.379999	2488.989716
81001	.000000	1128.296326	81002	.000000	1440.000000	81003	.000000	340.000000
811	-101.650000	241.449600	81105	.000000	243.888241	812	-89.020000	91.451921
81204	.000000	42.732785	813	-175.799999	1005.942123	81307	.000000	1437.088913
814	-291.079998	198.833300	81405	.000000	292.404247	82001	.000000	.000000
821	-38.500000	.000000	82204	.000000	.000000	823	-49.500000	946.611099
82307	.000000	1352.328613	824	-164.779999	357.611111	82405	.000000	525.902901
830	-18.080000	2687.865492	83001	.000000	1602.273956	83002	.000000	1560.000000
831	-27.500000	64.816500	83105	.000000	65.471146	832	-14.870000	64.816500
83204	.000000	66.819328	834	-142.779999	423.328407	83404	.000000	622.546761
910	-166.379999	2412.006866	91001	.000000	2447.726048	91003	.000000	390.000000
911	-101.650000	34.183600	91104	.000000	34.528858	912	-89.020000	226.191360
91205	.000000	233.180472	913	-175.799999	912.284790	91307	.000000	1303.290024
914	-291.079998	188.6[illegible]	91404	.000000	277.453243	92001	.000000	.000000
92104	.000000	.000000	92205	.000000	.000000	923	-49.500000	1668.449397
92307	.000000	1046.709976	92308	.000000	1336.829666	92404	.000000	.000000
930	-18.080000	1534.095795	93001	.000000	1804.863647	931	-27.500000	99.000099
93104	.000000	100.000000	932	-14.870000	291.007858	93205	.000000	300.000000
934	-142.779999	611.995102	93404	.000000	416.471146	93405	.000000	374.528858
93406	.000000	110.000000						

END PRIMAL OUTPUT

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DUAL OUTPUT

CASE ITERATION 184 OBJECTIVE VALUE -49228878.0

LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE
E COST	.000000	.000000	Z C510	.000000	.000000	Z C511	.000000	.000000
Z C512	.000000	.000000	Z C513	.000000	.000000	Z C514	.000000	.000000
Z C520	.000000	.000000	Z C521	.000000	.000000	Z C522	.000000	.000000
Z C523	.000000	.000000	Z C524	.000000	.000000	Z C530	.000000	-8.006800
Z C531	.000000	.000000	Z C532	.000000	.000000	Z C534	.000000	.000000
Z C610	.000000	-8.006800	Z C611	.000000	.000000	Z C612	.000000	.000000
Z C613	.000000	.000000	Z C614	.000000	.000000	Z C620	.000000	-8.006800
Z C621	.000000	62.518561	Z C622	.000000	.000000	Z C623	.000000	.000000
Z C624	.000000	.000000	Z C630	.000000	-8.006800	Z C631	.000000	.000000
Z C632	.000000	.000000	Z C634	.000000	.000000	Z C710	.000000	-8.006800
Z C711	.000000	.000000	Z C712	.000000	.000000	Z C713	.000000	.000000
Z C714	.000000	.000000	Z C720	.000000	-8.006800	Z C721	.000000	.000000
Z C722	.000000	.000000	Z C723	.000000	.000000	Z C724	.000000	.000000
Z C730	.000000	-8.006800	Z C731	.000000	.000000	Z C732	.000000	-84.178869
Z C734	.000000	.000000	Z C810	.000000	-8.006800	Z C811	.000000	.000000
Z C812	.000000	-84.178869	Z C813	.000000	.000000	Z C814	.000000	.000000
Z C820	.000000	-8.006800	Z C821	.000000	62.518560	Z C822	.000000	-84.178869
Z C823	.000000	.000000	Z C824	.000000	.000000	Z C830	.000000	-8.006800
Z C831	.000000	-84.178869	Z C832	.000000	.000000	Z C834	.000000	.000000
Z C910	.000000	-8.006800	Z C911	.000000	-84.178869	Z C912	.000000	.000000
Z C913	.000000	.000000	Z C914	.000000	.000000	Z C920	.000000	-8.006800
Z C921	.000000	-84.178869	Z C922	.000000	.000000	Z C923	.000000	.000000
Z C924	.000000	.000000	Z C930	.000000	.000000	Z C931	.000000	.000000
Z C932	.000000	.000000	Z C934	.000000	-84.178869	D301	.000000	.000000
D303	.000000	.000000	D104	.000000	.000000	D105	.000000	.000000
D106	.000000	.000000	D204	.000000	.000000	D205	.000000	.000000
D206	.000000	.000000	D107	.000000	.000000	D108	.000000	.000000
D109	.000000	.000000	D 4	.000000	.000000	D 5	.000000	.000000
D 6	.000000	.000000	D401	.000000	8.006800	D402	.000000	8.006800
D403	.000000	8.006800	D304	.000000	.000000	D305	.000000	.000000
D306	.000000	.000000	D207	.000000	.000000	D208	.000000	.000000
D209	.000000	.000000	D501	.000000	8.006800	D502	.000000	8.006800
D503	.000000	8.006800	D404	.000000	.000000	D405	.000000	.000000
D406	.000000	.000000	D307	.000000	.000000	D308	.000000	.000000
D309	.000000	.000000	D601	.000000	8.006800	D602	.000000	8.006800
D603	.000000	8.006800	D504	.000000	84.178869	D505	.000000	84.178869
D506	.000000	84.178869	D407	.000000	.000000	D408	.000000	.000000
D409	.000000	.000000	D701	.000000	8.006800	D702	.000000	8.006300
D703	.000000	8.006800	D604	.000000	.000000	D605	.000000	.000000
D606	.000000	.000000	D507	.000000	.000000	D508	.000000	.000000
D509	.000000	.000000	D801	.000000	.000000	D802	.000000	.000000
D803	.000000	.000000	D704	.000000	.000000	D705	.000000	.000000
D706	.000000	.000000	Z E51	.000000	-166.379999	Z E52	.000000	-40.080000
Z E53	.000000	-27.500000	Z E61	.000000	-175.799997	Z E62	.000000	-49.500000

BEST COPY AVAILABLE

LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE
Z E63	.000000	-27.500000	Z E71	.000000	-175.799997	Z E72	.000000	-99.500000
Z E73	.000000	-27.500000	Z E81	.000000	-175.799997	Z E82	.000000	-99.500000
Z E83	.000000	-27.500000	Z E91	.000000	-175.799997	Z E92	.000000	-99.500000
Z E93	.000000	-18.080000	F30	.000000	.000000	F11	.000000	.000000
F22	.000000	.000000	F13	.000000	6.593868	F 4	.000000	84.795321
F40	.000000	.000000	F21	.000000	.000000	F32	.000000	.000000
F14	.000000	78.389772	F23	.000000	.000000	F50	.000000	.000000
F31	.000000	.000000	F42	.000000	.000000	F24	.000000	78.389772
F33	.000000	.000000	F60	.000000	.000000	F41	.000000	.000000
F52	.000000	.000000	F34	.000000	78.389772	F43	.000000	.000000
F70	.000000	.000000	F51	.000000	10.770298	F62	.000000	.000000
F44	.000000	78.389772	F53	.000000	.000000	F80	.000000	.000000
F61	.000000	9.325809	F72	.000000	.000000	F54	.000000	168.974192
G11	.000000	64.082764	G22	.000000	75.041227	G13	.000000	.000000
G 4	.000000	.000000	G21	.000000	73.408571	G32	.000000	84.178873
G14	.000000	.000000	G23	.000000	.000000	G31	.000000	73.408571
G42	.000000	84.178873	G24	.000000	.000000	G33	.000000	.000000
G41	.000000	73.408571	G52	.000000	.000000	G34	.000000	.000000
G43	.000000	.000000	G51	.000000	.000000	G62	.000000	84.178873
G44	.000000	.000000	G53	.000000	.000000	G61	.000000	.000000
G72	.000000	3.113784	G54	.000000	.000000	H514	.000000	.000000
H531	.000000	74.149998	H532	.000000	74.150000	H534	.000000	.000000
H614	.000000	.000000	H631	.000000	74.149998	H632	.000000	74.150000
H634	.000000	.000000	H714	.000000	.000000	H731	.000000	74.149998
H732	.000000	74.149996	H734	.000000	.000000	H814	.000000	.000000
H831	.000000	74.149998	H832	.000000	74.150000	H834	.000000	.000000
H914	.000000	.000000	H931	.000000	.000000	H932	.000000	.000000
H934	.000000	.000000						

END DUAL OUTPUT

BEST COPY AVAILABLE

DUAL RANGE OUTPUT

CASE ITERATION 184 OBJECTIVE VALUE -4922878.0

LABEL	ORIG. ACT.	LABEL	LIMITS OF RANGE INCREMENT	LABEL	INCREMENT
D301	4810.000000	S23	-277.272335	513	546.261169
D303	538.000000	S23	-277.272335	513	546.261169
D401	4810.000000	G23	-245.666262	623	840.061272
D402	2152.000000	G23	-245.666262	613	3031.940155
D403	538.000000	G23	-245.666262	623	840.061272
D501	4810.000000	71001	-1721.390381	71307	117.388183
D502	2152.000000	71002	-2152.000000	71307	117.388183
D503	538.000000	71003	-538.000000	71307	117.388183
D601	4200.000000	81001	-1128.296326	813	1183.490891
D602	1440.000000	81002	-1440.000000	813	1183.490891
D603	360.000000	81003	-360.000000	813	1183.490891
D504	550.000000	F52	.000000	G52	200.000004
D505	440.000000	F52	.000000	G52	200.000004
D506	110.000000	F52	.000000	G52	200.000004
D701	4050.000000	D508	-447.318989	91307	1073.303024
D702	1560.000000	D508	-447.318989	91307	1073.303024
D703	390.000000	91003	-390.000000	91307	1073.303024
D507	2350.000000	D508	-543.170341	92308	1336.829666
F13	-1000.000000	S2002	-723.335045	52307	336.686161
F 4	-900.000000	G 4	-10.000000	52307	346.584530
F14	-900.000000	G14	-10.000000	G23	307.077610
F24	-900.000000	G24	-10.000000	H634	474.027473
F34	-900.000000	G34	-10.000000	824	525.902893
F51	-100.000000	F52	.000000	911	34.528854
F44	-900.000000	G44	-10.000000	H834	527.227408
F61	-100.000000	G61	-200.000000	H931	48.765708
F54	-900.000000	F52	.000000	G52	200.000004
G11	300.000000	F11	-200.000000	513	468.999931
G22	300.000000	F22	-200.000008	513	478.657581
G21	300.000000	F21	-200.000002	613	2603.113281
G32	300.000000	F32	-200.000002	613	2656.716414
G31	300.000000	F31	-200.000002	71307	100.785214
G42	300.000000	F42	-200.000002	713	102.840584
G41	300.000000	F41	-200.000002	81307	1014.102150
G62	300.000000	F62	-200.000000	D605	366.819328
G72	300.000000	F72	-200.000000	D705	300.000000
H531	-86.895599	61104	-210.104700	53104	86.895598
H532	-86.895599	61204	-204.112263	53204	86.895598
H534	-86.895599	H614	-257.821709	53404	86.895598
H631	-62.714600	71104	-234.285700	63104	62.714599
H632	-62.714600	71204	-228.293262	63204	62.714599
H714	-226.944399	H634	-322.336105	71404	226.944397
H731	-55.550700	81105	-241.449600	73104	55.550699

BEST COPY AVAILABLE

LABEL	ORIG. ACT.	LIMITS OF RANGE LABEL	INCREMENT	LABEL	INCREMENT
H732	-55.550700	81204	-41.451921	73204	55.550699
H734	-55.550700	82405	-357.611111	73404	55.550699
H814	-198.833300	82405	-357.611111	81405	198.833298
H831	-64.816500	91104	-34.183400	83105	64.816499
H832	-64.816500	91205	-226.191360	83204	64.816499
H914	-188.666698	H834	-358.511909	91404	188.666697
S1A	.000000	S2307	-235.675596	S13	464.310394
S1002	.000000	S23	-277.272335	S13	546.261169
S1105	.000000	D104	-3800.000041	S1104	300.000000
S1106	.000000	D104	-3800.000041	S1104	300.000000
S1205	.000000	D204	-3500.000092	S1204	300.000000
S1206	.000000	D204	-3500.000092	S1204	300.000000
S1308	.000000	D107	-6500.000000	S1307	663.313843
S1309	.000000	D107	-6500.000000	S1307	663.313843
S1405	.000000	D 4	-4100.000000	S1404	900.000000
S1406	.000000	D 4	-4100.000000	S1404	900.000000
S2A	.000000		-9999.000000	S2002	506.324398
S2001	.000000	S13	-546.261169	S23	277.272335
S2003	.000000	S13	-546.261169	S23	277.272335
S21	.000000	S2104	.000000	S23	235.675600
S2105	.000000	D104	-3800.000041	S2104	.000000
S2106	.000000	D104	-3800.000041	S2104	.000000
S22	.000000	S2204	.000000	S23	235.675600
S2205	.000000	D204	-3500.000092	S2204	.000000
S2206	.000000	D204	-3500.000092	S2204	.000000
S2308	.000000	D107	-6500.000000	S2307	336.686157
S2309	.000000	D107	-6500.000000	S2307	336.686157
S24	.000000	S2404	.000000	S23	235.675600
S2405	.000000	D 4	-4100.000000	S2404	.000000
S2406	.000000	D 4	-4100.000000	S2404	.000000
S3A	.000000	G23	-208.811104	G23	714.034233
S3002	.000000	G2001	-543.066925	G23	840.061272
S3105	.000000	D204	-3500.000092	S3104	87.773244
S3106	.000000	D204	-3500.000092	S3104	87.773244
S3205	.000000	D304	-4318.307312	S3204	89.580671
S3206	.000000	D304	-4318.307312	S3204	89.580671
S3405	.000000	D104	-3800.000041	S3404	127.788668
S3406	.000000	D104	-3800.000041	S3404	127.788668
G1A	.000000	G23	-208.811104	G13	2577.084717
G1001	.000000	G23	-840.061272	G2001	543.066925
G1003	.000000	G23	-840.061272	S3003	538.000000
G1105	.000000	D204	-3500.000092	G1104	212.226757
G1106	.000000	D204	-3500.000092	G1104	212.226757
G1205	.000000	D304	-4318.307312	G1204	210.419331
G1206	.000000	D304	-4318.307312	G1204	210.419331
G1308	.000000	D207	-2798.307556	G1307	3681.623199
G1309	.000000	D207	-2798.307556	D209	1500.000000
G1405	.000000	D104	-3800.000041	G1404	772.211334

BEST COPY AVAILABLE

LABEL	ORIG. ACT.	LABEL	LIMITS OF RANGE INCREMENT	LABEL	INCREMENT
61406	.000000	D104	-3600.000061	61404	772.211334
62A	.000000	G23	-208.811104	623	714.034233
62002	.000000	620	-543.066948	623	840.061272
62003	.000000	53001	-4266.933105	53003	538.000000
62104	.000000	621	.000000	611	212.226755
62105	.000000	621	.000000	611	212.226755
62106	.000000	621	.000000	611	212.226755
622	.000000	62204	.000000	61204	204.112263
62205	.000000	D304	-4318.307312	62204	.000000
62206	.000000	D304	-4318.307312	62204	.000000
62308	.000000	D207	-2798.307556	62307	1020.069298
62309	.000000	D207	-2798.307556	62307	1020.069298
62404	.000000	624	.000000	H614	379.152603
62405	.000000	624	.000000	H614	379.152603
62406	.000000	624	.000000	H614	379.152603
63A	.000000	71001	-1963.145248	71307	99.777461
63002	.000000	71001	-1721.390381	71002	2152.000000
63003	.000000	71001	-1721.390381	71003	538.000000
63105	.000000	D304	-4318.307312	63104	63.348016
63106	.000000	D304	-4318.307312	63104	63.348016
63205	.000000	D404	-3743.888336	63204	64.652479
63206	.000000	D404	-3743.888336	63204	64.652479
63405	.000000	D204	-3500.000092	63404	566.255569
63406	.000000	D204	-3500.000092	63404	566.255569
71A	.000000	G33	-1957.911911	71307	99.777461
71105	.000000	D304	-4318.307312	71104	236.651985
71106	.000000	D304	-4318.307312	71104	236.651985
71205	.000000	D404	-3743.888336	71204	235.347523
71206	.000000	D404	-3743.888336	71204	235.347523
71308	.000000	D307	-5296.358643	71307	142.542080
71309	.000000	D307	-5296.358643	71307	142.542080
71405	.000000	D204	-3500.000092	71404	333.744431
71406	.000000	D204	-3500.000092	71404	333.744431
72A	.000000	G33	-1957.911896	F33	842.532127
720	.000000	72002	.000000	72307	1442.740677
72001	.000000	71002	-2152.000000	72002	.000000
72003	.000000	71002	-2152.000000	72002	.000000
721	.000000	72104	.000000	71104	234.285700
72105	.000000	D304	-4318.307312	72104	.000000
72106	.000000	D304	-4318.307312	72104	.000000
722	.000000	72204	.000000	71204	228.293262
72205	.000000	D404	-3743.888336	72204	.000000
72206	.000000	D404	-3743.888336	72204	.000000
72308	.000000	D307	-5296.358643	72307	2061.099335
72309	.000000	D307	-5296.358643	D309	1600.000000
724	.000000	72404	.000000	H634	322.336105
72405	.000000	D204	-3500.000092	72404	.000000
72406	.000000	D204	-3500.000092	72404	.000000

BEST COPY AVAILABLE

LABEL	ORIG. ACT.	- - - - - - LIMITS OF RANGE - - - - - - LABEL	INCREMENT	LABEL	INCREMENT
73A	.000000	81001	-959.027901	813	1005.942123
73002	.000000	81001	-1128.296326	81002	1440.000000
73003	.000000	81001	-1128.296326	81003	360.000000
73105	.000000	D404	-3743.888336	73104	56.111761
73106	.000000	D404	-3743.888336	73104	56.111761
73205	.000000	93404	-415.471146	73204	57.267215
73206	.000000	93404	-415.471146	73204	57.267215
73405	.000000	D304	-4318.307312	73404	81.492858
73406	.000000	D304	-4318.307312	73404	81.492858
81A	.000000	G43	-1547.376801	813	1005.942123
81104	.000000	D405	-3756.111786	81105	243.888241
81106	.000000	D405	-3756.111786	81105	243.888241
81205	.000000	93404	-415.471146	81204	42.732785
81206	.000000	93404	-415.471146	81204	42.732785
81308	.000000	D407	-4710.582458	81307	1437.088913
81309	.000000	D407	-4710.582458	81307	1437.088913
81404	.000000	D305	-3181.692871	81405	292.404247
81406	.000000	D305	-3181.692871	81405	292.404247
82A	.000000	G43	-1547.376785	82307	946.611092
820	.000000	82001	.000000	82307	946.611092
82002	.000000	81001	-1128.296326	82001	.000000
82003	.000000	81001	-1128.296326	82001	.000000
82104	.000000	821	.000000	811	243.888239
82105	.000000	821	.000000	811	243.888239
82106	.000000	821	.000000	811	243.888239
822	.000000	82204	.000000	81204	41.451921
82205	.000000	93404	-415.471146	82204	.000000
82206	.000000	93404	-415.471146	82204	.000000
82308	.000000	D407	-4710.582458	82307	1352.328613
82309	.000000	D407	-4710.582458	82307	1352.328613
82404	.000000	D305	-3181.692871	82405	525.902901
82406	.000000	D305	-3181.692871	82405	525.902901
83A	.000000	D508	-380.211436	91307	912.284775
83003	.000000	91001	-2447.726044	91003	390.000000
83104	.000000	93405	-374.528854	83105	65.471146
83105	.000000	93405	-374.528854	83105	65.471146
83205	.000000	D604	-583.180672	83204	66.819328
83206	.000000	D604	-583.180672	83204	66.819328
83405	.000000	D404	-3743.888336	83404	622.546741
83406	.000000	D404	-3743.888336	83404	622.546741
91A	.000000	D508	-380.211436	91307	912.284775
91002	.000000	83001	-1602.273956	83002	1560.000000
91105	.000000	93404	-415.471146	91104	34.528854
91106	.000000	93404	-415.471146	91104	34.528854
91204	.000000	D605	-366.819328	91205	233.180672
91206	.000000	D605	-366.819328	D606	150.000000
91308	.000000	92307	-1046.709974	91307	1303.290024
91309	.000000	D508	-543.170341	D509	470.000000

BEST COPY AVAILABLE

LABEL	ORIG. ACT.	LIMITS OF RANGE LABEL	INCREMENT	LABEL	INCREMENT
91405	.000000	D404	-3743.888336	91404	277.453243
91406	.000000	D404	-3743.888336	91404	277.453243
92A	.000000	D508	-380.211632	92308	935.762047
920	.000000	92001	.000000	92307	732.682335
92002	.000000	83001	-1602.273956	92001	.000000
92003	.000000	91001	-2447.726044	92001	.000000
921	.000000	92104	.000000	91104	34.183400
92105	.000000	93404	-415.471146	92104	.000000
92106	.000000	93404	-415.471146	92104	.000000
922	.000000	92205	.000000	91205	226.191360
92204	.000000	D405	-366.819328	92205	.000000
92206	.000000	D405	-366.819328	92205	.000000
92309	.000000	D508	-543.170341	D509	470.000000
924	.000000	92404	.000000	H834	358.511909
92405	.000000	D404	-3743.888336	92404	.000000
92406	.000000	D404	-3743.888336	92404	.000000
93A	.000000	D801	-1015.840523	F80	684.116982
93002	.000000	D801	-1195.136368	D802	1200.000000
93003	.000000	D801	-1195.136368	D803	300.000000
93105	.000000	D404	-583.180472	93104	100.000000
93106	.000000	D404	-583.180472	93104	100.000000
93204	.000000	D705	-300.000000	93205	300.000000
93206	.000000	D705	-300.000000	D706	150.000000

END DUAL RANGE OUTPUT

BEST COPY AVAILABLE

REDCST OUTPUT

CASE ITERATION 184 OBJECTIVE VALUE -4922878.0

LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST
Z C510	.000000	.000000	Z C511	.000000	.000000	Z C512	.000000	.000000
Z C513	.000000	.000000	Z C514	.000000	.000000	Z C520	.000000	.000000
Z C521	.000000	.000000	Z C522	.000000	.000000	Z C523	.000000	.000000
Z C524	.000000	.000000	Z C530	.000000	-8.006800	Z C531	.000000	.000000
Z C532	.000000	.000000	Z C534	.000000	.000000	Z C610	.000000	-8.006800
Z C611	.000000	.000000	Z C612	.000000	.000000	Z C613	.000000	.000000
Z C614	.000000	.000000	Z C620	.000000	-8.006800	Z C621	.000000	62.518561
Z C622	.000000	.000000	Z C623	.000000	.000000	Z C624	.000000	.000000
Z C630	.000000	-8.006800	Z C631	.000000	.000000	Z C632	.000000	.000000
Z C634	.000000	.000000	Z C710	.000000	-8.006800	Z C711	.000000	.000000
Z C712	.000000	.000000	Z C713	.000000	.000000	Z C714	.000000	.000000
Z C720	.000000	-8.006800	Z C721	.000000	.000000	Z C722	.000000	.000000
Z C723	.000000	.000000	Z C724	.000000	.000000	Z C730	.000000	-8.006800
Z C731	.000000	.000000	Z C732	.000000	-84.178869	Z C734	.000000	.000000
Z C810	.000000	-8.006800	Z C811	.000000	.000000	Z C812	.000000	-84.178869
Z C813	.000000	.000000	Z C814	.000000	.000000	Z C820	.000000	-8.006800
Z C821	.000000	62.518560	Z C822	.000000	-84.178869	Z C823	.000000	.000000
Z C824	.000000	.000000	Z C830	.000000	-8.006800	Z C831	.000000	-84.178869
Z C832	.000000	.000000	Z C834	.000000	.000000	Z C910	.000000	-8.006800
Z C911	.000000	-84.178869	Z C912	.000000	.000000	Z C913	.000000	.000000
Z C914	.000000	.000000	Z C920	.000000	-8.006800	Z C921	.000000	-84.178869
Z C922	.000000	.000000	Z C923	.000000	.000000	Z C924	.000000	.000000
Z C930	.000000	.000000	Z C931	.000000	.000000	Z C932	.000000	.000000
Z C934	.000000	-84.178869	D301	.000000	.000000	D303	.000000	.000000
D401	.000000	8.006800	D402	.000000	8.006800	D403	.000000	8.006800
D501	.000000	8.006800	D502	.000000	8.006800	D503	.000000	8.006800
D601	.000000	8.006800	D602	.000000	8.006800	D603	.000000	8.006800
D504	.000000	84.178869	D505	.000000	84.178869	D506	.000000	84.178869
D701	.000000	8.006800	D702	.000000	8.006800	D703	.000000	8.006800
D507	.000000	.000000	Z E51	.000000	-166.379999	Z E52	.000000	-40.080000
Z E53	.000000	-27.500000	Z E61	.000000	-175.799997	Z E62	.000000	-49.500000
Z E63	.000000	-27.500000	Z E71	.000000	-175.799997	Z E72	.000000	-49.500000
Z E73	.000000	-27.500000	Z E81	.000000	-175.799997	Z E82	.000000	-49.500000
Z E83	.000000	-27.500000	Z E91	.000000	-175.799997	Z E92	.000000	-49.500000
Z E93	.000000	-18.080000	F13	.000000	6.593868	F 4	.000000	84.795321
F14	.000000	78.389772	F24	.000000	78.389772	F34	.000000	78.389772
F51	.000000	10.770298	F44	.000000	78.389772	F61	.000000	9.325809
F54	.000000	168.974194	G11	.000000	64.082768	G22	.000000	75.041227
G21	.000000	73.408571	G32	.000000	84.178873	G31	.000000	73.408571
G42	.000000	84.178873	G41	.000000	73.408571	G62	.000000	84.178873
G72	.000000	3.113784	H531	.000000	74.149998	H532	.000000	74.150000
H534	.000000	.000000	H631	.000000	74.149998	H632	.000000	74.150000
H714	.000000	.000000	H731	.000000	74.149998	H732	.000000	74.149996
H734	.000000	.000000	H814	.000000	.000000	H831	.000000	74.149998

BEST COPY AVAILABLE

LABEL	COST	REDUCED COST
H832	.000000	74.150000
51002	.000000	.000000
51205	.000000	.000000
51309	.000000	.000000
52A	-320.189999	280.110001
521	-38.500000	63.149999
522	-25.870000	63.150000
52308	.000000	.000000
52405	.000000	.000000
53002	.000000	.000000
53205	.000000	.000000
53406	.000000	.000000
61003	.000000	.000000
61205	.000000	.000000
61309	.000000	.000000
62A	-320.189999	270.690002
62104	.000000	62.518541
622	-25.870000	63.150000
62308	.000000	.000000
62405	.000000	.000000
63002	.000000	.000000
63106	.000000	.000000
63405	.000000	.000000
71105	.000000	.000000
71206	.000000	.000000
71405	.000000	.000000
720	-40.080000	.000000
721	-38.500000	63.149998
722	-25.870000	63.149998
72308	.000000	.000000
72405	.000000	.000000
73002	.000000	.000000
73106	.000000	.000000
73405	.000000	.000000
81104	.000000	.000000
81206	.000000	.000000
81404	.000000	.000000
820	-40.080000	.000000
82104	.000000	62.518560
822	-25.870000	63.149994
82308	.000000	.000000
82406	.000000	.000000
83104	.000000	.000000
83206	.000000	.000000
91A	-320.189999	144.390003
91104	.000000	.000000
91308	.000000	.000000
91406	.000000	.000000
92002	.000000	.000000

LABEL	COST	REDUCED COST
H914	.000000	.000000
51105	.000000	.000000
51206	.000000	.000000
51405	.000000	.000000
52001	.000000	.000000
52105	.000000	.000000
52205	.000000	.000000
52309	.000000	.000000
52406	.000000	.000000
53105	.000000	.000000
53206	.000000	.000000
61A	-320.189999	144.390003
61105	.000000	.000000
61206	.000000	.000000
61405	.000000	.000000
62002	.000000	.000000
62105	.000000	62.518546
62205	.000000	.000000
62309	.000000	.000000
62406	.000000	.000000
63003	.000000	.000000
63205	.000000	.000000
63406	.000000	.000000
71106	.000000	.000000
71308	.000000	.000000
71406	.000000	.000000
72001	.000000	.000000
72105	.000000	.000000
72205	.000000	.000000
72309	.000000	.000000
72406	.000000	.000000
73003	.000000	.000000
73205	.000000	.000000
73406	.000000	.000000
81106	.000000	.000000
81308	.000000	.000000
81406	.000000	.000000
82002	.000000	.000000
82105	.000000	62.518560
82205	.000000	.000000
82309	.000000	.000000
83A	-320.189999	292.690002
83106	.000000	.000000
83405	.000000	.000000
91002	.000000	.000000
91209	.000000	.000000
91309	.000000	.000000
92A	-320.189999	270.689999
92003	.000000	.000000

LABEL	COST	REDUCED COST
51A	-320.189999	153.810001
51106	.000000	.000000
51308	.000000	.000000
51406	.000000	.000000
52003	.000000	.000000
52106	.000000	.000000
52206	.000000	.000000
524	-164.779999	.000000
53A	-320.189999	292.690002
53106	.000000	.000000
53405	.000000	.000000
61001	.000000	.000000
61106	.000000	.000000
61308	.000000	.000000
61406	.000000	.000000
62003	.000000	.000000
62106	.000000	62.518541
62206	.000000	.000000
62404	.000000	.000000
63A	-320.189999	292.690002
63105	.000000	.000000
63206	.000000	.000000
71A	-320.189999	144.390003
71205	.000000	.000000
71309	.000000	.000000
72A	-320.189999	270.689999
72003	.000000	.000000
72106	.000000	.000000
72206	.000000	.000000
724	-164.779999	.000000
73A	-320.189999	292.690002
73105	.000000	.000000
73206	.000000	.000000
81A	-320.189999	144.390003
81205	.000000	.000000
81309	.000000	.000000
82A	-320.189999	270.689999
82003	.000000	.000000
82106	.000000	62.518560
82206	.000000	.000000
82404	.000000	.000000
83003	.000000	.000000
83205	.000000	.000000
83406	.000000	.000000
91105	.000000	.000000
91206	.000000	.000000
91405	.000000	.000000
920	-40.080000	.000000
921	-38.500000	63.149998

BEST COPY AVAILABLE

LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST
92105	.000000	.000000	92104	.000000	.000000	922	-28.870000	63.149998
92204	.000000	.000000	92206	.000000	.000000	92309	.000000	.000000
924	-164.779999	.000000	92405	.000000	.000000	92406	.000000	.000000
93A	-320.189999	302.110001	93002	.000000	.000000	93003	.000000	.000000
93105	.000000	.000000	93104	.000000	.000000	93204	.000000	.000000
93206	.000000	.000000	Z *B1	.000000	**********			

END REDCST OUTPUT

BEST COPY AVAILABLE

PRIMAL RANGE OUTPUT

CASE ITERATION 184 OBJECTIVE VALUE -4922878.0

LABEL	COST	LABEL	LIMITS OF RANGE INCREMENT	LABEL	INCREMENT
COST	.000000	F51	-1.000000		9999.000000
D104	.000000	F14	-78.389772	S1105	.000000
D105	.000000	S1105	.000000		9999.000000
D106	.000000	S1106	.000000		9999.000000
D204	.000000	F24	-78.389772	S1205	.000000
D205	.000000	S1205	.000000		9999.000000
D206	.000000	S1206	.000000		9999.000000
D107	.000000	F13	-6.593868	S1308	.000000
D108	.000000	S1308	.000000		9999.000000
D109	.000000	S1309	.000000		9999.000000
D 4	.000000	F 4	-84.795321	S1405	.000000
D 5	.000000	S1405	.000000		9999.000000
D 6	.000000	S1406	.000000		9999.000000
D304	.000000	H734	.000000	S3205	.000000
D305	.000000	S3205	.000000	H734	.000000
D306	.000000	S3206	.000000		9999.000000
D207	.000000	D401	-6.593868	61308	.000000
D208	.000000	61308	.000000		9999.000000
D209	.000000	61309	.000000		9999.000000
D404	.000000	81104	.000000	63205	.000000
D405	.000000	63205	.000000	81104	.000000
D406	.000000	63206	.000000		9999.000000
D307	.000000	D501	-6.593868	71308	.000000
D308	.000000	71308	.000000		9999.000000
D309	.000000	71309	.000000		9999.000000
D407	.000000	D601	-6.593868	81308	.000000
D408	.000000	81308	.000000		9999.000000
D409	.000000	81309	.000000		9999.000000
D604	.000000	91204	.000000	83205	.000000
D605	.000000	83205	.000000	91204	.000000
D606	.000000	83206	.000000		9999.000000
D508	.000000	D507	.000000	91309	.000000
D509	.000000	91309	.000000		9999.000000
D801	.000000	G72	-2.728432	93002	.000000
D802	.000000	93002	.000000		9999.000000
D803	.000000	93003	.000000		9999.000000
D704	.000000	93204	.000000		9999.000000
D705	.000000		-9999.000000	93204	.000000
D706	.000000	93206	.000000		9999.000000
F30	.000000	F13	-8.006800	G11	55.019125
F11	.000000	G11	-64.082764		9999.000000
F22	.000000	G22	-75.041227		9999.000000
F40	.000000	D401	-8.006800	/	9999.000000

BEST COPY AVAILABLE

LABEL	COST	LABEL	LIMITS OF RANGE INCREMENT	LABEL	INCREMENT
F21	.000000	G21	-73.408571		9999.000000
F32	.000000	G32	-84.178873		9999.000000
F23	.000000	F14	-80.694386	D401	6.593868
F50	.000000	D501	-8.006800		9999.000000
F31	.000000	G31	-73.408571		9999.000000
F42	.000000	G42	-84.178873		9999.000000
F33	.000000	F24	-80.694386	D501	6.593868
F60	.000000	D601	-8.006800		9999.000000
F41	.000000	G41	-73.408571		9999.000000
F52	.000000	F51	-10.770298		9999.000000
F43	.000000	F34	-80.694386	D601	6.593868
F70	.000000	D701	-8.006800		9999.000000
F62	.000000	G62	-84.178873		9999.000000
F53	.000000	F61	-7.615202	D701	6.593868
F80	.000000	F61	-8.006800	G72	2.728432
F72	.000000	G72	-3.113784		9999.000000
G13	.000000	F13	-6.593868		9999.000000
G 4	.000000	F 4	-84.795321		9999.000000
G14	.000000	F14	-78.389772		9999.000000
G23	.000000	D401	-6.593868	F14	80.694386
G24	.000000	F24	-78.389772		9999.000000
G33	.000000	D501	-6.593868	F24	80.694386
G52	.000000		-9999.000000	F51	10.770298
G34	.000000	F34	-78.389772		9999.000000
G43	.000000	D601	-6.593868	F34	80.694386
G51	.000000	F51	-10.770298		9999.000000
G44	.000000	F44	-78.389772		9999.000000
G53	.000000	D701	-6.593868	F51	7.615202
G61	.000000	F61	-9.325809		9999.000000
G54	.000000	F54	-168.974194		9999.000000
H514	.000000	S24	.000000	F 4	124.699998
H614	.000000	H534	.000000	F14	115.279999
H634	.000000	H714	.000000	F24	115.279999
H834	.000000	H914	.000000	F44	115.279999
H931	.000000		-9999.000000	F61	9.420000
H932	.000000	G72	-3.[illegible]10000		9999.000000
H934	.000000		-9999.000000	F54	248.493448
S10	-166.379999	D301	.000000	S1002	.000000
S1001	.000000	D301	.000000		9999.000000
S1003	.000000	D303	.000000		9999.000000
S11	-101.650000	S21	-63.149999		9999.000000
S1104	.000000	S1105	.000000		9999.000000
S12	-89.020000	S22	-63.150000		9999.000000
S1204	.000000	S1205	.000000		9999.000000
S13	-175.799999	S1002	.000000	D301	.000000
S1307	.000000	S1002	.000000	D301	.000000
S14	-291.079998	S24	.000000	F 4	124.699998
S1404	.000000	S1405	.000000	F 4	84.795321

BEST COPY AVAILABLE

LABEL	COST	LABEL	LIMITS OF RANGE INCREMENT	LABEL	INCREMENT
620	-40.080000	S1002	.000000	D301	.000000
S2002	.000000	S1002	.000000	D301	.000000
S2104	.000000	S2105	.000000	S21	62.518541
S2204	.000000	S2205	.000000	S22	61.257154
S23	-49.500000	D301	.000000	S1002	.000000
S2307	.000000	D301	.000000	S1002	.000000
S2484	.000008	S2405	.000000	S24	.000000
630	-18.080000	H534	.000000		9999.000000
S3001	.000000	H534	.000000	61003	.000000
S3003	.000000	61003	.000000		9999.000000
631	-27.500000		-9999.000000	H531	74.149998
S3104	.000000	S3105	.000008	H531	73.408571
632	-14.870000		-9999.000000	H532	74.150000
S3204	.000000	S3205	.000000	H532	71.927443
634	-142.779999		-9999.000000	H534	.000008
S3404	.000000	S3405	.000000	H534	.000000
610	-166.379999	S3002	.000000	61001	.000000
61002	.000000	S3002	.000000		9999.000000
611	-101.650000	62104	-63.149998		9999.000000
61104	.000000	61105	.000000		9999.000000
612	-89.020000	622	-63.150000		9999.000000
61204	.000000	61205	.000000		9999.000000
613	-175.799999	61001	.000000	H534	.000000
61307	.000000	61001	.000000	H534	.000000
614	-291.079998	H534	.000000	F14	115.279999
61404	.000000	H534	.000000	F14	78.389772
620	-40.080000	61001	.000000	H534	.000000
62001	.000000	61001	.000000	H534	.000000
621	-38.500000		-9999.000000	62104	63.149998
62204	.000000	62205	.000000	622	61.257154
623	-49.500000	H534	.000000	61001	.000000
62307	.000000	H534	.000000	61001	.000000
624	-164.779999		-9999.000000	62404	.000000
630	-18.080000	H631	-74.149998	H714	.000000
63001	.000000	63002	.000000	H714	.000000
631	-27.500000		-9999.000000	H631	74.149998
63104	.000000	63105	.000000	H631	73.408571
632	-14.870000		-9999.000000	H632	74.150000
63204	.000000	63205	.000000	H632	71.927443
634	-142.779999	H714	.000000	F24	115.279999
63404	.000000	H714	.000000	F24	78.389772
710	-166.379999	H714	.000000	H631	74.149998
71001	.000000	H714	.000000	63002	.000000
71002	.000000	63002	.000000	72001	.000000
71003	.000000	63003	.000000		9999.000000
711	-101.650000	721	-63.149998		9999.000000
71104	.000000	71105	.000000		9999.000000
712	-89.020000	722	-63.149998		9999.000000

BEST COPY AVAILABLE

LABEL	COST	LABEL	LIMITS OF RANGE - - - - - - INCREMENT	LABEL	INCREMENT
71204	.000000	71205	.000000		9999.000000
713	-175.799999	F24	-115.280000	720	.000000
71307	.000000	71308	.000000	720	.000000
714	-291.079998		-9999.000000	H714	.000000
71404	.000000	71405	.000000	H714	.000000
72002	.000000	72001	.000000	720	.000000
72104	.000000	72105	.000000	721	62.518560
72204	.000000	72205	.000000	722	61.257152
723	-49.500000	720	.000000		9999.000000
72307	.000000	720	.000000		9999.000000
72404	.000000	72405	.000000	724	.000000
730	-18.080000	H734	.000000		9999.000000
73001	.000000	H734	.000000		9999.000000
731	-27.500000		-9999.000000	H731	74.149998
73104	.000000	73105	.000000	H731	73.408571
732	-14.870000		-9999.000000	H732	74.149996
73204	.000000	73205	.000000	H732	71.927439
734	-142.779999		-9999.000000	H734	.000000
73404	.000000	73405	.000000	H734	.000000
810	-166.379999	820	.000000	H734	.000000
81001	.000000	820	.000000	H734	.000000
81002	.000000	73002	.000000		9999.000000
81003	.000000	73003	.000000		9999.000000
811	-101.650000	82104	-63.149997		9999.000000
81105	.000000	81104	.000000		9999.000000
812	-89.020000	F51	-11.103100		9999.000000
81204	.000000	81205	.000000		9999.000000
813	-175.799999	H734	.000000	820	.000000
81307	.000000	H734	.000000	820	.000000
814	-291.079998		-9999.000000	H814	.000000
81405	.000000	81404	.000000	H814	.000000
82001	.000000	82002	.000000	820	.000000
821	-38.500000		-9999.000000	82104	63.149997
82204	.000000	82205	.000000	822	61.257149
823	-49.500000	820	.000000	H734	.000000
82307	.000000	820	.000000	H734	.000000
824	-164.779999	H734	.000000	F34	115.279999
82405	.000000	H734	.000000	F34	78.389772
830	-18.080000	H831	-74.149998	H914	.000000
83001	.000000	83003	.000000	H914	.000000
83002	.000000	91002	.000000		9999.000000
831	-27.500000		-9999.000000	H831	74.149998
83105	.000000	83104	.000000	H831	73.408571
832	-14.870000		-9999.000000	H832	74.150000
83204	.000000	83205	.000000	H832	71.927443
834	-142.779999	H914	.000000	F44	115.279999
83404	.000000	H914	.000000	F44	78.389772
910	-166.379999	H914	.000000	H831	74.149998

BEST COPY AVAILABLE

		- - - - - - LIMITS OF RANGE - - - - - -			
LABEL	COST	LABEL	INCREMENT	LABEL	INCREMENT
91001	.000000	H919	.000000	83003	.000000
91003	.000000	83003	.000000		9999.000000
911	-101.650000	921	-63.149998	F51	10.879078
91109	.000000	91105	.000000	F51	10.770298
912	-89.020000	922	-63.149998		9999.000000
91205	.000000	91209	.000000		9999.000000
913	-175.799999	F51	-10.879078	920	.000000
91307	.000000	91308	.000000	920	.000000
919	-291.079998		-9999.000000	H919	.000000
91409	.000000	91485	.000000	H919	.000000
92001	.000000	92002	.000000	920	.000000
92109	.000000	92105	.000000	921	62.51[illegible]560
92205	.000000	92209	.000000	922 .	61.257152
923	-49.500000	920	.000000		9999.000000
92307	.000000	D507	.000000	91308	.000000
92308	.000000	91308	.000000	D507	.000000
92409	.000000	92405	.000000	924	.000000
930	-18.080000	F61	-9.420000	672	3.210000
93001	.000000	93002	.000000	672	2.728432
931	-27.500000		-9999.000000	F61	9.420000
93109	.000000	93105	.000000	F61	9.325809
932	-19.870000	672	-3.210000		9999.000000
93205	.000000	93209	.000000		9999.000000
934	-142.779999		-9999.000000	F59	248.993998
93409	.000000	83109	.000000	73205	.000000
93405	.000000	73205	.000000	83109	.000000
93406	.000000	73206	.000000		9999.000000

END PRIMAL RANGE OUTPUT

BEST COPY AVAILABLE

BEST COPY AVAILABLE

Appendix C

TOPOPS Report Generator Output of Modified Baseline Case - Quality Maximization

BEST COPY AVAILABLE

AIR FORCE HUMAN RESOURCE LABORATORY
PERSONNEL RESEARCH DIVISION
TOPOPS OFFICER PROCUREMENT
ANNUAL PROCUREMENT SCHEDULE

DATE OF REPORT: 27 JULY 1973 OBJECTIVE: MAXIMIZE QUALITY

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
PROCUREMENT REQUIREMENTS										
PILOT						5589	4811	4045	3579	3396
NAVIGATOR						867	1149	1309	1177	1440
NONRATED						4295	3207	2871	3246	2638
TOTAL						10751	9167	8265	8002	7474
TRAINING REQUIREMENTS										
PILOT	0	0	0	0	6209	5345	4538	3976	3773	0
NAVIGATOR	0	0	0	0	742	1175	1442	1304	1668	0
NONRATED	0	0	0	0	0	4344	3135	2777	3240	2536
TOTAL	0	0	0	0	6951	10864	9115	8057	8681	2536
RECRUITMENT REQUIREMENTS										
SMSO-MALE										
PILOT	0	0	0	1017	2682	2029	1446	0	0	
NAVIGATOR	0	0	0	872	147	0	299	1962	0	
NONRATED	0	0	0	0	4415	3159	2424	3194	1571	
AFCP										
PILOT	0	250	300	0	300	0	0	0	0	
NAVIGATOR	0	0	0	0	0	0	0	0	0	
NONRATED	0	0	0	300	0	100	300	0	0	
RCP										
PILOT	0	0	300	210	209	0	0	0	0	
NAVIGATOR	0	0	0	0	0	0	0	0	0	
NONRATED	0	0	0	90	10	100	300	300	0	
AFROTC										
PILOT	0	5000	3500	2938	3500	4700	0	0	0	
NAVIGATOR	0	0	1500	2061	1500	0	0	0	0	
NONRATED	0	0	0	0	0	0	0	0	0	
AIR FORCE ACADEMY										
PILOT	910	160	700	0	710	0	0	0	0	
NAVIGATOR	0	0	0	0	0	0	0	0	0	
NONRATED	0	741	210	910	199	900	0	0	0	
TOTAL										
PILOT	910	5426	4800	4965	7481	6729	1446	0	0	
NAVIGATOR	0	0	1500	2933	1647	0	299	1962	0	
NONRATED	0	741	210	1300	4624	4259	3024	3494	1571	

AIR FORCE HUMAN RESOURCE LABORATORY
PERSONNEL RESEARCH DIVISION
TOPOPS OFFICER PROCUREMENT
AGGREGATE COST ESTIMATES
(IN MILLIONS)

DATE OF REPORT: 27 JULY 1973 OBJECTIVE: MAXIMIZE QUALITY

PROGRAM COSTS	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	177.3	216.5	162.2	131.9	45.5	733.4
AFCP	26.0	38.4	.0	32.9	8.2	105.4
RCP	27.2	18.3	26.4	4.3	4.3	80.6
AFROTC	307.6	241.3	216.5	241.3	289.2	1296.0
AIR FORCE ACADEMY	126.1	26.9	113.5	9.7	114.0	390.1
TOTAL	664.2	541.3	518.6	420.2	461.2	2605.5

PROGRAM COSTS (WITH TURNOVER)	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	354.6	433.0	324.3	263.9	91.0	1466.0
AFCP	26.0	38.4	.0	32.9	8.2	105.4
RCP	27.2	18.3	26.4	4.3	4.3	80.6
AFROTC	615.3	482.7	433.1	482.7	578.4	2592.1
AIR FORCE ACADEMY	252.1	53.7	226.9	19.3	228.1	780.2
TOTAL	1275.2	1026.0	1010.7	803.1	910.0	5025.0

AIR FORCE HUMAN RESOURCE LABORATORY
PERSONNEL RESEARCH DIVISION
TOPOPS OFFICER PROCUREMENT
COST ANALYSIS

DATE OF REPORT: 27 JULY 1973 OBJECTIVE: MAXIMIZE QUALITY

I. COST PER OFFICER

	PAY AND ALLOWANCES	OTHER COSTS	TOTAL COSTS
SMSO-MALE	4540	0	4540
AFCP	23000	0	23000
RCP	10370	0	10370
AFROTC	9250	0	9250
AIR FORCE ACADEMY	66890	0	66890
AVERAGE	12114.	0.	12114.

II. COST PERCENTAGES

	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	26.7	40.0	31.3	31.4	9.9	28.1
AFCP	3.9	7.1	.0	7.0	1.9	4.0
RCP	4.1	3.4	5.1	1.0	.9	3.1
AFROTC	46.3	44.6	41.0	57.4	62.7	49.7
AIR FORCE ACADEMY	19.0	5.0	21.9	2.3	24.7	15.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

III. COST PERCENTAGES (WITH TURNOVER)

	1970	1971	1972	1973	1974	TOTAL
SMSO-MALE	27.8	42.2	32.1	32.9	19.8	29.[illegible]
AFCP	2.0	3.7	.0	4.1	.9	2.[illegible]
RCP	2.1	1.8	2.6	.5	.5	1.6
AFROTC	48.3	47.0	42.0	60.1	63.6	51.6
AIR FORCE ACADEMY	19.8	5.2	22.5	2.4	25.1	15.5
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

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AIR FORCE HUMAN RESOURCE LABORATORY
PERSONNEL RESEARCH DIVISION
TOPOPS OFFICER PROCUREMENT
OFFICER QUALITY PROFILE

DATE OF REPORT: 27 JULY 1973 — OBJECTIVE: MAXIMIZE QUALITY

I. AVERAGE QUALITY

	1970	1971	1972	1973	1974	AVERAGE
SMSO-MALE	61.	65.	55.	68.	68.	62.
AECP	90.	70.	0.	70.	80.	75.
RCP	90.	70.	90.	70.	80.	82.
AFROTC	76.	76.	76.	76.	62.	73.
AIR FORCE ACADEMY	90.	70.	90.	70.	72.	83.
AVERAGE	71.	70.	70.	72.	64.	70.

II. SOURCE OF SUPPLY (1970-74)

	SMSO-MALE	AECP	RCP	AFROTC	AIR FORCE ACADEMY						TOTAL
ELIG COLL GRAD-LOW	12706.	0.	0.	0.	0.	0.	0.	0.	0.	0.	12706.
ELIG COLL GRAD-MED	18656.	0.	0.	0.	0.	0.	0.	0.	0.	0.	18656.
ELIG COLL GRAD-HI	2664.	0.	0.	0.	0.	0.	0.	0.	0.	0.	2664.
ELIG HS GRAD - LOW	0.	0.	0.	0.	558.	0.	0.	0.	0.	0.	558.
ELIG HS GRAD - MED	0.	1140.	671.	0.	920.	0.	0.	0.	0.	0.	2730.
ELIG HS GRAD-HI	0.	418.	929.	0.	3972.	0.	0.	0.	0.	0.	5320.
ELIGIBLE ROTC-LOW	0.	0.	0.	2358.	0.	0.	0.	0.	0.	0.	2358.
ELIGIBLE ROTC-MED	0.	0.	0.	15880.	0.	0.	0.	0.	0.	0.	15880.
ELIGIBLE ROTC-HI	0.	0.	0.	6470.	0.	0.	0.	0.	0.	0.	6470.

AIR FORCE HUMAN RESOURCE LABORATORY
PERSONNEL RESEARCH DIVISION
TOPOPS OFFICER PROCUREMENT
OFFICER QUALITY PROFILE

DATE OF REPORT: 27 JULY 1973 — OBJECTIVE: MAXIMIZE QUALITY

III. OFFICERS BY PRODUCTION AGENCY

	1970	1971	1972	1973	1974	TOTAL
PILOT						
SMSO-MALE	1544.	2280.	1725.	1230.	0.	6780.
AECP	256.	297.	0.	297.	0.	850.
RCP	291.	284.	280.	0.	0.	775.
AFROTC	3580.	2450.	2857.	2450.	3290.	13747.
AIR FORCE ACADEMY	619.	115.	476.	0.	483.	1693.
NAVIGATOR						
SMSO-MALE	742.	126.	0.	254.	1668.	2790.
AECP	0.	0.	0.	0.	0.	0.
RCP	0.	0.	0.	0.	0.	0.
AFROTC	0.	1050.	1443.	1050.	0.	3543.
AIR FORCE ACADEMY	0.	0.	0.	0.	0.	0.
NONRATED						
SMSO-MALE	3753.	2685.	2862.	2715.	1336.	12552.
AECP	0.	297.	0.	99.	297.	693.
RCP	97.	11.	97.	291.	291.	777.
AFROTC	0.	0.	0.	0.	0.	0.
AIR FORCE ACADEMY	504.	143.	619.	135.	612.	2013.

AIR FORCE HUMAN RESOURCE LABORATORY
PERSONNEL RESEARCH DIVISION
TOPOPS OFFICE - PROCUREMENT
PROCUREMENT POLICY ANALYSIS

DATE OF REPORT: 27 JULY 1973 OBJECTIVE: MAXIMIZE QUALITY

CONSTRAINT	MARGINAL IMPROVEMENT	RANGE		
D302	9.90	2104.	TO	2337.
D303	29.90	490.	TO	723.
D106	20.00	336.	TO	1160.
D206	20.00	300.	TO	1210.
D109	20.00	0.	TO	5000.
D402	20.00	1890.	TO	2683.
D403	40.00	284.	TO	4563.
D306	20.00	910.	TO	1210.
D309	20.00	1026.	TO	1600.
D502	20.00	0.	TO	3159.
D503	40.00	0.	TO	2030.
D405	20.00	711.	TO	1011.
D309	20.00	0.	TO	2939.
D602	20.00	0.	TO	1447.
D603	40.00	299.	TO	2725.
D504	10.00	550.	TO	560.
D505	30.00	440.	TO	450.
D506	50.00	110.	TO	120.
D409	20.00	1492.	TO	1863.
D702	20.00	710.	TO	2805.
D703	40.00	0.	TO	1635.
D606	20.00	0.	TO	300.
D507	0.02	2157.	TO	2361.
D508	20.02	1607.	TO	1891.
D509	40.02	277.	TO	491.
D802	20.00	0.	TO	1272.
D803	40.00	0.	TO	372.
D706	20.00	0.	TO	300.
F25	17.06	-100.	TO	-90.
F15	10.24	-100.	TO	-90.
G22	1.41	250.	TO	462.
G31	20.51	4941.	TO	5224.
G40	41.92	900.	TO	1000.
G12	11.76	100.	TO	756.
G23	12.94	100.	TO	765.
G41	30.00	900.	TO	1574.
G32	20.02	4592.	TO	5645.
G13	11.76	100.	TO	1165.
G24	12.94	289.	TO	1183.

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AIR FORCE HUMAN RESOURCE LABORATORY
PERSONNEL RESEARCH DIVISION
TOPOPS OFFICER PROCUREMENT
PROCUREMENT POLICY ANALYSIS

DATE OF REPORT: 27 JULY 1973 OBJECTIVE: MAXIMIZE QUALITY

CONSTRAINT	MARGINAL IMPROVEMENT	RANGE		
G42	30.00	900.	TO	2169.
G33	28.82	3561.	TO	6811.
G14	11.76	100.	TO	386.
G43	30.00	900.	TO	1000.
G34	28.82	2700.	TO	5000.
G26	12.94	100.	TO	450.
G44	30.00	900.	TO	2466.
G16	11.76	150.	TO	362.
G27	12.94	150.	TO	363.

END OF TOPOPS OFFICER PROCUREMENT MODEL.

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PRIMAL OUTPUT

CASE ITERATION 185 OBJECTIVE VALUE 4138392.7

LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY
E GUAL	.000000	-.4130393+07	D301	.000000	4810.000000	D104	.000000	5000.000000			
D105	.000000	3831.591797	D204	.000000	5000.000000	D205	.000000	3490.000000			
D107	.000000	7500.000000	D108	.000000	2500.000000	D 4	.000000	5000.000000			
D 5	.000000	4000.000000	D 6	.000000	90.000000	D401	.000000	253.666321			
D304	.000000	5000.000000	D305	.000000	3490.000000	D207	.000000	7500.000000			
D208	.000000	2500.000000	D501	.000000	2310.895142	D404	.000000	5000.000000			
D405	.000000	3490.000000	D307	.000000	7500.000000	D308	.000000	2500.000000			
D401	.000000	1820.488002	D407	.000000	7500.000000	D408	.000000	2500.000000			
D701	.000000	842.374083	D604	.000000	750.000000	D605	.000000	150.000000			
D801	.000000	2920.203500	D704	.000000	750.000000	D705	.000000	450.000000			
F 3	.000000	1600.000000	F11	.000000	150.400182	F22	.000000	200.000000			
F31	.000000	4000.000000	F40	.000000	10.000000	F 4	.000000	6246.333740			
F12	.000000	200.000000	F23	.000000	200.000000	F41	.000000	10.000000			
F32	.000000	4000.000000	F 5	.000000	4189.104950	F13	.000000	200.000000			
F24	.000000	200.000000	F42	.000000	10.000000	F33	.000000	4000.000031			
F 6	.000000	3171.511169	F14	.000000	200.000000	F43	.000000	10.000000			
F34	.000000	4000.000000	F 7	.000000	4157.620117	F26	.000000	200.000000			
F44	.000000	10.300000	F35	.000000	3700.000031	F 8	.000000	571.916412			
F16	.000000	200.000000	F27	.000000	200.000000	F45	.000000	.000000			
G11	.000000	41.591919	G25	.000000	200.000000	G15	.000000	200.000000			
G35	.000000	300.000000	G45	.000000	10.000000	510	.000000	1544.442041			
51002	70.000000	1270.037019	51003	90.000000	530.000000	511	.000000	255.824356			
51106	90.000000	258.408184	512	.000000	291.007858	51206	90.000000	300.000000			
513	.000000	3400.929932	51308	70.000000	3500.000000	51309	90.000000	1500.000000			
514	.000000	610.795044	51406	90.000000	910.000000	520	.000000	741.999992			
52002	70.000000	872.962902	52105	70.000000	.000000	52205	70.000000	.000000			
523	.000000	.000000	52406	90.000000	.000000	530	.000000	3753.196991			
53001	50.000000	4025.464172	53003	90.000000	390.172066	53106	90.000000	.000000			
537	.000000	87.382361	53206	90.000000	90.000000	534	.000000	504.278400			
534 6	50.000000	741.591912	610	.000000	2280.382111	61001	50.000000	530.869591			
61002	70.000000	2152.000000	611	.000000	297.000290	61105	70.000000	300.000000			
612	.000000	200.705502	61205	70.000000	210.000000	613	.000000	2449.958958			
61308	70.000000	3500.000000	614	.000000	114.516647	61405	70.000000	160.400182			
620	.000000	125.658604	62003	90.000000	147.827934	62106	90.000000	.000000			
62206	90.000000	.000000	623	.000000	1049.978989	62309	90.000000	1500.000000			
62406	90.000000	.000000	630	.000000	2685.373047	63001	50.000000	1007.341305			
63002	70.000000	2152.000000	631	.000000	297.000290	63105	70.000000	300.000000			
632	.000000	10.564314	63205	70.000000	10.006623	634	.000000	142.790059			
63405	70.000000	210.000000	710	.000000	1725.255875	71001	50.000000	1491.763535			
71003	90.000000	530.000000	71106	90.000000	.000000	712	.000000	200.447548			
71206	90.000000	200.113377	713	.000000	2057.189301	71308	70.000000	1438.900696			
71309	90.000000	1500.000000	714	.000000	475.996189	71406	90.000000	700.000000			
72002	70.000000	.000000	72105	70.000000	.000000	72205	70.000000	.000000			
723	.000000	1442.740692	72308	70.000000	2061.099335	72405	70.000000	.000000			
730	.000000	2061.737305	73001	50.000000	2364.751068	73003	90.000000	60.002066			

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LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY	LABEL	COST	ACTIVITY
73106	90.000000	.000000	732	.000000	97.002620	73206	90.000000	100.000000
734	.000000	610.795044	73406	90.000000	910.000000	810	.000000	1229.715347
81001	50.000000	6.760110	81002	70.000000	1440.000000	811	.000000	297.000290
81105	71.000000	300.000000	81205	70.000000	.000000	813	.000000	2449.950950
81300	70.000000	3500.000000	81405	70.000000	.000000	820	.000000	254.243210
82003	90.000000	299.117134	82106	90.000000	.000000	82206	90.000000	.000000
823	.000000	1049.970909	82309	90.000000	1500.000000	82406	90.000000	.000000
830	.000000	2715.423126	83001	50.000000	1244.695312	83002	70.000000	1560.000000
83003	90.000000	390.000000	831	.000000	99.000099	83105	70.000000	90.000000
83106	90.000000	10.000000	832	.000000	291.007050	83205	70.000000	300.000000
834	.000000	135.396009	83405	70.000000	199.113377	91003	90.000000	.000000
91106	90.000000	.000000	912	.000000	.000000	913	.000000	3209.934265
91307	50.000000	2350.000000	91300	70.000000	1800.000000	91309	90.000000	470.000000
914	.000000	403.399040	91406	90.000000	710.006627	920	.000000	1660.444397
92001	50.000000	1960.924020	92106	90.000000	.000000	92205	70.000000	.000000
92307	50.000000	.000000	92406	90.000000	.000000	930	.000000	1336.095566
93001	50.000000	71.916409	93002	70.000000	1200.000000	93003	90.000000	300.000000
931	.000000	297.000290	93105	70.000000	150.000000	93106	90.000000	150.000000
932	.000000	291.007050	93205	70.000000	150.000000	93206	90.000000	150.000000
934	.000000	611.995102	93404	50.000000	550.000000	93405	70.000000	350.000000

END PRIMAL OUTPUT

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DUAL OUTPUT

CASE ITERATION 185 OBJECTIVE VALUE 4138392.7

LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE
E DUAL	.000000	.000000	Z C510	.000000	60.099447	Z C511	.000000	70.000000
Z C512	.000000	70.000000	Z C513	.000000	70.000000	Z C514	.000000	90.000000
Z C520	.000000	60.099446	Z C521	.000000	70.000000	Z C522	.000000	70.000000
Z C523	.000000	70.000000	Z C524	.000000	90.000000	Z C530	.000000	50.000000
Z C531	.000000	70.000000	Z C532	.000000	70.000000	Z C534	.000000	70.000000
Z C610	.000000	50.000000	Z C611	.000000	70.000000	Z C612	.000000	70.000000
Z C613	.000000	70.000000	Z C614	.000000	70.000000	Z C620	.000000	49.999999
Z C621	.000000	70.000000	Z C622	.000000	70.000000	Z C623	.000000	70.000000
Z C624	.000000	70.000000	Z C630	.000000	50.000000	Z C631	.000000	70.000000
Z C632	.000000	70.000000	Z C634	.000000	70.000000	Z C710	.000000	50.000000
Z C711	.000000	70.000000	Z C712	.000000	70.000000	Z C713	.000000	70.000000
Z C714	.000000	70.000000	Z C720	.000000	49.999999	Z C721	.000000	70.000000
Z C722	.000000	70.000000	Z C723	.000000	70.000000	Z C724	.000000	70.000000
Z C730	.000000	50.000000	Z C731	.000000	70.000000	Z C732	.000000	40.000679
Z C734	.000000	70.000000	Z C810	.000000	50.000000	Z C811	.000000	70.000000
Z C812	.000000	40.000679	Z C813	.000000	70.000000	Z C814	.000000	70.000000
Z C820	.000000	49.999999	Z C821	.000000	70.000000	Z C822	.000000	40.000679
Z C823	.000000	70.000000	Z C824	.000000	70.000000	Z C830	.000000	50.000000
Z C831	.000000	40.000679	Z C832	.000000	70.000000	Z C834	.000000	70.000000
Z C910	.000000	49.999999	Z C911	.000000	40.000679	Z C912	.000000	69.999999
Z C913	.000000	41.176676	Z C914	.000000	70.000000	Z C920	.000000	50.000000
Z C921	.000000	40.000679	Z C922	.000000	70.000000	Z C923	.000000	41.176676
Z C924	.000000	70.000000	Z C930	.000000	50.000000	Z C931	.000000	70.000000
Z C932	.000000	70.000000	Z C934	.000000	40.000679	D381	.000000	.000000
D382	.000000	9.900554	D383	.000000	29.900553	D184	.000000	.000000
D185	.000000	.000000	D186	.000000	20.000000	D284	.000000	.000000
D285	.000000	.000000	D286	.000000	20.000000	D187	.000000	.000000
D188	.000000	.000000	D189	.000000	20.000000	D 4	.000000	.000000
D 5	.000000	.000000	D 6	.000000	.000000	D481	.000000	.000000
D482	.000000	20.000001	D483	.000000	40.000001	D384	.000000	.000000
D385	.000000	.000000	D386	.000000	20.000000	D287	.000000	.000000
D288	.000000	.000000	D289	.000000	20.000000	D581	.000000	.000000
D582	.000000	20.000001	D583	.000000	40.000001	D484	.000000	.000000
D485	.000000	.000000	D486	.000000	20.000000	D387	.000000	.000000
D388	.000000	.000000	D389	.000000	20.000000	D681	.000000	.000000
D682	.000000	20.000001	D683	.000000	40.000001	D584	.000000	9.999321
D585	.000000	29.999321	D586	.000000	49.999321	D487	.000000	.000000
D488	.000000	.000000	D489	.000000	20.000000	D781	.000000	.000000
D782	.000000	20.000001	D783	.000000	40.000001	D684	.000000	.000000
D685	.000000	.000000	D686	.000000	20.000000	D587	.000000	8.823324
D588	.000000	20.823324	D589	.000000	40.823324	D881	.000000	.000000
D882	.000000	20.000000	D883	.000000	40.000000	D784	.000000	.000000
D785	.000000	.000000	D786	.000000	20.000000	Z E51	.000000	70.707000
Z E52	.000000	70.707000	Z E53	.000000	50.824999	Z E61	.000000	50.824999

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10 AUG 73 .001.009.002

LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE	LABEL	COST	SHADOW PRICE
Z F62	.000000	58.824999	Z E63	.000000	58.824999	Z F71	.000000	58.824999
Z F72	.000000	58.824999	Z E73	.000000	58.824999	Z E81	.000000	58.824999
Z F82	.000000	58.824999	Z E83	.000000	58.824999	Z F91	.000000	58.824999
Z F92	.000000	58.824999	Z E93	.000000	58.824999	F 3	.000000	.000000
F11	.000000	.000000	F22	.000000	.000000	F31	.000000	.000000
F41	.000000	.000000	F 4	.000000	.000000	F12	.000000	.000000
F23	.000000	.000000	F41	.000000	.000000	F32	.000000	.000000
F 5	.000000	.000000	F13	.000000	.000000	F24	.000000	.000000
F42	.000000	.000000	F33	.000000	.000000	F 6	.000000	.000000
F14	.000000	.000000	F25	.000000	17.861111	F43	.000000	.000000
F34	.000000	.000000	F 7	.000000	.000000	F15	.000000	18.236128
F26	.000000	.000000	F44	.000000	.000000	F35	.000000	.000000
F 8	.000000	.000000	F16	.000000	.000000	F27	.000000	.000000
F45	.000000	.000000	G11	.000000	.000000	G22	.000000	1.412358
G31	.000000	28.546891	G48	.000000	41.919625	G12	.000000	11.763193
G23	.000000	12.938218	G41	.000000	29.999321	G32	.000000	28.823325
G13	.000000	11.763193	G24	.000000	12.938218	G42	.000000	29.999321
G33	.000000	24.823325	G14	.000000	11.763193	G25	.000000	.000000
G43	.000000	29.999321	G34	.000000	28.823325	G15	.000000	.000000
G26	.000000	12.938218	G44	.000000	29.999321	G35	.000000	.000000
G16	.000000	11.763193	G27	.000000	12.938218	G45	.000000	.000000

END DUAL OUTPUT

DUAL RANGE OUTPUT

CASE ITERATION 185 OBJECTIVE VALUE 4138392.7

- - - - - - LIMITS OF RANGE - - - - - -

LABEL	ORIG. ACT.	LABEL	INCREMENT	LABEL	INCREMENT
D382	2152.000000	G11	-48.443496	F11	184.583748
D383	538.000000	G11	-48.443496	F11	184.583748
D186	1000.000000	61001	-663.575786	614	168.480100
D286	1000.000000	714	-699.999992	63405	210.000000
D189	1500.000000	51309	-1500.000000	51308	3500.000000
D482	2152.000000	D401	-253.666321	61001	530.869591
D483	538.000000	D401	-253.666321	53001	4025.464172
D386	1000.000000	53206	-90.000000	612	280.999998
D289	1500.000000	53003	-473.770004	62003	179.584654
D582	2152.000000	63002	-2152.000000	63001	1007.341385
D583	538.000000	71903	-538.000000	71001	1491.763535
D486	1000.000000	712	-289.113373	63205	10.996623
D389	1500.000000	71309	-1500.000000	71308	1438.900696
D682	1440.000000	81402	-1440.000000	81001	6.760118
D683	360.000000	73003	-60.002866	73001	2364.751068
D584	550.000000	F45	.000000	G45	10.000000
D585	440.000000	F45	.000000	G45	10.000000
D586	110.000000	F45	.000000	G45	10.000000
D489	1500.000000	81001	-8.220673	820	363.211849
D782	1560.000000	D701	-942.379883	83001	1244.695312
D783	300.000000	93003	-390.000000	83001	1244.695312
D686	150.000000	D605	-150.000000	93105	150.000000
D587	2350.000000	834	-193.426739	63205	10.575784
D588	1800.000000	834	-193.426739	63205	10.575784
D589	470.000000	834	-193.426739	63205	10.575784
D882	1230.000000	93402	-1230.000000	93401	71.916489
D883	300.000000	93403	-300.000000	93001	71.916489
D786	150.000000	93206	-150.000000	93205	150.000000
F25	-100.000000	F45	.000000	G45	10.000000
F15	-100.000000	F45	.000000	G45	10.000000
G22	300.000000	G11	-42.448278	F11	161.678126
G31	5000.000000	G11	-58.823952	F11	224.839137
G42	910.000000	F49	-10.000000	D 6	90.000000
G12	300.000000	F12	-200.000000	61001	455.785275
G23	300.000000	F23	-200.000000	61001	465.178811
G41	910.000000	F41	-10.000000	61001	663.575786
G32	5000.000000	D401	-300.821854	61001	644.624146
G13	300.000000	F13	-200.000000	63001	864.866585
G24	300.000000	63205	-10.996623	63001	882.675926
G42	910.000000	F42	-10.000000	63001	1259.155319
G33	5000.000000	71308	-1438.900696	71001	1811.418121
G14	300.000000	F14	-200.000000	81001	5.803991
G43	910.000000	F43	-10.000000	53206	90.000000

BEST COPY AVAILABLE

LABEL	ORIG. ACT.	- - - - - - LIMITS OF RANGE - - - - - - LABEL	INCREMENT	LABEL	INCREMENT
G34	500.000000	D541	-2222.256875	A1001	0.200673
G26	300.000000	F26	-200.000000	D605	150.000000
G44	910.000000	F44	-10.000000	A3001	1555.842697
G16	300.000000	93105	-150.000000	93001	61.744806
G27	300.000000	93205	-150.000000	93001	63.816256
516	.000000	G11	-41.175942	F11	156.824257
51401	.000000	G11	-48.443496	F11	184.503748
51104	.000000	61001	-663.575706	614	160.400100
51105	.000000	61001	-663.575706	614	160.400100
51204	.000000	714	-699.999992	63405	210.000000
51205	.000000	714	-699.999992	63405	210.000000
51307	.000000	0108	-2500.000000	51308	3500.000000
51404	.000000	0 6	-90.000000	51406	910.000000
51405	.000000	0 6	-90.000000	51406	910.000000
524	.000000	G11	-41.175943	F11	156.824263
52001	.000000	G11	-48.443496	F11	184.503748
52003	.000000	51002	-1279.037018	51003	530.000000
521	.000000	52105	.000000	61405	166.724260
52104	.000000	0105	-3831.591797	52105	.000000
52106	.000000	614	-160.400100	52105	.000000
522	.000000	52205	.000000	63405	203.705502
50204	.000000	0205	-3490.000000	52205	.000000
52206	.000000	63405	-210.000000	52205	.000000
52307	.000000	523	.000000	52002	1060.021179
52308	.000000	523	.000000	52002	1060.021179
52309	.000000	523	.000000	52002	1060.021179
524	.000000	52406	.000000	514	610.795044
52404	.000000	0 6	-90.000000	52406	.000000
52405	.000000	0 6	-90.000000	52406	.000000
530	.000000	0401	-215.610983	53001	3421.550021
53002	.000000	61001	-530.069591	61002	2152.000000
531	.000000	53106	.000000	61105	297.000290
53104	.000000	714	-699.999992	53106	.000000
53105	.000000	714	-699.999992	53106	.000000
53204	.000000	532	-90.000003	612	209.999998
53205	.000000	532	-90.000003	612	209.999998
53404	.000000	61001	-663.575706	614	160.400100
53405	.000000	61001	-663.575706	614	160.400100
614	.000000	0401	-215.610983	61001	451.227071
61003	.000000	53001	-4025.464172	53003	390.172066
61104	.000000	0205	-3490.000000	61105	300.000000
61106	.000000	63405	-210.000000	61105	300.000000
61204	.000000	0305	-3490.000000	61205	210.000000
61206	.000000	612	-209.999998	53206	90.000000
61307	.000000	0208	-2500.000000	61308	3500.000000
61309	.000000	62003	-179.584454	53003	473.770004
61404	.000000	0105	-3831.591797	61405	160.400102
61406	.000000	614	-160.400100	61001	663.575706

BEST COPY AVAILABLE

LABEL	ORIG. ACT.	- - - - - - LIMITS OF RANGE - - - - - - LABEL	INCREMENT	LABEL	INCREMENT
624	.000000	0401	-215.610005	62003	125.650603
62001	.000000	53003	-390.172066	62003	147.827934
62002	.000000	53003	-390.172066	62003	147.827934
621	.000000	62106	.000000	62003	125.650603
62104	.000000	714	-699.999992	62106	.000000
62105	.000000	714	-699.999992	62106	.000000
622	.000000	62206	.000000	53206	87.302358
62204	.000000	53206	-90.000000	62206	.000000
62205	.000000	53206	-90.000000	62206	.000000
62307	.000000	53003	-473.778004	62003	179.584454
62308	.000000	53003	-473.778004	62003	179.584454
624	.000000	62406	.000000	62003	125.650603
62404	.000000	61001	-663.575706	62406	.000000
62405	.000000	61001	-663.575706	62406	.000000
630	.000000	0501	-1964.211777	63001	856.210773
63703	.000000	71001	-1491.763535	71003	530.000000
63104	.000000	0305	-3490.000000	63105	300.000000
63106	.000000	612	-289.999998	53206	90.000000
63204	.000000	0405	-3490.000000	63205	10.006623
63206	.000000	632	-10.006628	712	289.113373
63404	.000000	0205	-3490.000000	63405	210.000000
63406	.000000	634	-210.000002	714	699.999992
710	.000000	0501	-1964.211777	71001	1267.967300
71002	.000000	63301	-1007.341385	71001	1491.763535
711	.000000	71106	.000000	53206	89.100009
71104	.000000	53206	-90.000000	71106	.000000
71105	.000000	53206	-90.000000	71106	.000000
71204	.000000	712	-289.113373	63205	10.006623
71205	.000000	712	-289.113373	63205	10.006623
71307	.000000	0308	-2500.000000	71308	1438.900696
71404	.000000	714	-699.999992	63405	210.000000
71405	.000000	714	-699.999992	63405	210.000000
720	.000000	71308	-1007.210342	71001	1267.967316
720	.000000	72302	.000000	71001	1267.967316
72001	.000000	63002	-2152.000000	72002	.000000
72003	.000000	71001	-1491.763535	72002	.000000
721	.000000	72105	.000000	63105	297.000290
72104	.000000	0305	-3490.000000	72105	.000000
72106	.000000	612	-289.999998	72105	.000000
722	.000000	72205	.000000	63205	10.560310
72204	.000000	0405	-3490.000000	72205	.000000
72206	.000000	63205	-10.006623	72205	.000000
72307	.000000	0308	-2500.000000	72308	2861.899335
72309	.000000	71308	-1438.900696	71309	1500.000000
724	.000000	72405	.000000	63405	142.790057
72404	.000000	0205	-3490.000000	72405	.000000
72406	.000000	63405	-210.000000	72405	.000000
730	.000000	0601	-1554.176712	73001	2009.900159

BEST COPY AVAILABLE

		- - - - - - LIMITS OF RANGE - - - - - -			
LABEL	ORIG. ACT.	LABEL	INCREMENT	LABEL	INCREMENT
73002	.000000	81001	-6.760118	81002	1440.000000
731	.000000	73106	.000000	712	286.222527
73104	.000000	712	-289.113373	73106	.000000
73105	.000000	712	-289.113373	73106	.000000
73204	.000000	83106	-10.000000	83105	90.000000
73205	.000000	83106	-10.000000	83105	90.000000
73404	.000000	53206	-90.000000	612	289.999998
73405	.000000	53206	-90.000000	612	289.999998
814	.000000	0601	-1554.176712	81001	5.745956
81003	.000000	73001	-2364.751068	81001	6.760118
81104	.000000	0435	-3490.000000	81105	300.000000
81106	.000000	63205	-10.996623	712	289.113373
812	.000000	81205	.000000	81001	5.745956
81204	.000000	93405	-350.000000	81205	.000000
81206	.000000	83105	-90.000000	81205	.000000
81307	.000000	0408	-2500.000000	81308	3500.000000
81309	.000000	829	-363.211849	81001	8.289673
814	.000000	81405	.000000	81001	5.745956
81404	.000000	0305	-3490.000000	81405	.000000
81406	.000000	612	-289.999998	81405	.000000
824	.000000	73403	-51.749142	82003	254.243208
82001	.000000	73003	-60.882866	82003	299.117134
82002	.000000	81001	-6.760118	82003	299.117134
821	.000000	82106	.000000	82003	254.243208
82104	.000000	712	-289.113373	82106	.000000
82105	.000000	712	-289.113373	82106	.000000
822	.000000	82206	.000000	73206	97.882628
82204	.000000	83106	-10.000000	82206	.000000
82205	.000000	83106	-10.000000	82206	.000000
82307	.000000	81001	-8.289673	828	363.211849
82308	.000000	81001	-8.289673	828	363.211849
824	.000000	82406	.000000	82003	254.243208
82404	.000000	53206	-90.000000	82406	.000000
82405	.000000	53206	-90.000000	82406	.000000
836	.000000	0721	-716.904997	83001	1057.964569
83104	.000000	93405	-350.000000	83105	90.000000
83204	.000000	0605	-150.000000	83205	300.000000
83206	.000000	93105	-150.000000	93106	150.000000
83404	.000000	0435	-3490.000000	83405	199.113377
83406	.000000	63205	-10.996623	83405	199.113377
916	.000000	834	-135.396009	63205	7.482845
918	.000000	91003	.000000	63205	7.482845
91001	.000000	83003	-390.000000	91003	.000000
91002	.000000	83003	-390.000000	91003	.000000
911	.000000	91106	.000000	63205	7.482845
91104	.000000	83106	-10.000000	91106	.000000
91105	.000000	83106	-10.000000	91106	.000000
91204	.000000	912	.000000	63205	7.631592

BEST COPY AVAILABLE

18 AUG 73 .001.011.005

		- - - - - - LIMITS OF RANGE - - - - - -			
LABEL	ORIG. ACT.	LABEL	INCREMENT	LABEL	INCREMENT
91285	.000000	912	.000000	63285	7.631592
91286	.000000	912	.000000	63285	7.631592
91484	.000000	712	-289.113373	63285	10.886623
91485	.000000	712	-289.113373	63285	10.886623
924	.000000	D741	-716.004997	92801	1668.444382
92882	.000000	83801	-1244.695312	83802	1568.000000
92883	.000000	83801	-1244.695312	83803	398.000000
921	.000000	92186	.000000	83186	9.980010
92184	.000000	83126	-10.000000	92186	.000000
92185	.000000	83126	-10.000000	92186	.000000
922	.000000	92285	.000000	83285	291.007858
92284	.000000	D685	-150.000000	92285	.000000
92286	.000000	93185	-150.000000	92285	.000000
923	.000000	92387	.000000	834	135.396009
92388	.000000	91387	-2350.000000	92387	.000000
92389	.000000	91387	-2350.000000	92387	.000000
924	.000000	92486	.000000	834	135.396011
92484	.000000	712	-289.113373	92486	.000000
92485	.000000	712	-289.113373	92486	.000000
934	.000000	D881	-2488.006038	93481	61.127419
93184	.000000	D685	-150.000000	93185	150.000000
93284	.000000	D785	-450.000000	93285	150.000000
93486	.000000	83185	-90.000000	83186	10.000000

END DUAL RANGE OUTPUT

BEST COPY AVAILABLE

BEST COPY AVAILABLE

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10 AUG 73                                                                                  .001.012.001
FILE OFF                                                                  14:14:02
RANGES PRIMAL                                                             14:14:03

10 AUG 73                                                                                  .001.013.001
                          PRIMAL RANGE OUTPUT
   CASE                ITERATION  185 OBJECTIVE VALUE  4130392.7
                        - - - - - - LIMITS OF RANGE - - - - - -
    LABEL      COST      LABEL    INCREMENT   LABEL    INCREMENT
   QUAL        .000000          -9999.000000 52001      1.000000
   D301        .000000 52001     -10.099446          9999.000000
   D104        .000000 51104     -20.000000          9999.000000
   D105        .000000 G22        -1.441442 52001     11.763190
   D204        .000000 51204     -20.000000          9999.000000
   D205        .000000 D206      -20.000000 G22        1.412358
   D107        .000000 51307     -20.000000          9999.000000
   D108        .000000 D109      -20.000000 51307     20.000000
   D  4        .000000 51404     -40.000000          9999.000000
   D  5        .000000 51405     -20.000000          9999.000000
   D  6        .000000          -9999.000000 51405     20.000000
   D401        .000000 G12       -10.099449 62A       50.000000
   D304        .000000 53204     -20.000000          9999.000000
   D305        .000000 D306      -20.000000 G13       11.763193
   D207        .000000 61307     -20.000000          9999.000000
   D208        .000000 D209      -20.000000 61307     20.000000
   D501        .000000 G13       -10.099449 72A       49.999999
   D404        .000000 63204     -20.000000          9999.000000
   D405        .000000 D406      -20.000000 G14       11.763193
   D307        .000000 71307     -20.000000          9999.000000
   D308        .000000 D309      -20.000000 71307     20.000000
   D601        .000000 G14       -10.099449 F25       14.949681
   D407        .000000 81307     -20.000000          9999.000000
   D408        .000000 D409      -20.000000 81307     20.000000
   D701        .000000 D507      -10.713983 F15       15.656875
   D604        .000000 91204     -19.999999          9999.000000
   D605        .000000 D606      -20.000000 G16       11.763193
   D801        .000000 G16       -10.099449 93A       50.000000
   D704        .000000 93204     -20.000000          9999.000000
   D705        .000000 D706      -20.000000 G27       12.938210
   F 3         .000000 D302       -9.900554 52001     10.099446
   F11         .000000 52001     -11.763190 G22        1.441442
   F22         .000000 G22        -1.412358          9999.000000
   F31         .000000 G31       -20.506091          9999.000000
   F40         .000000 G40       -41.919625          9999.000000
   F 4         .000000 62A       -50.000000 G12       10.099449
   F12         .000000 G12       -11.763193          9999.000000
   F23         .000000 G23       -12.938210          9999.000000
   F41         .000000 G41       -29.999321          9999.000000
   F32         .000000 G32       -28.823325          9999.000000
   F 5         .000000 72A       -49.999999 G13       10.099449
   F13         .000000 G13       -11.763193          9999.000000
   F24         .000000 G24       -12.938210          9999.000000
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LABEL	COST	LIMITS OF RANGE LABEL	INCREMENT	LABEL	INCREMENT
F42	.000000	G42	-29.999321		9999.000000
F33	.000000	G33	-28.823325		9999.000000
F 6	.000000	F25	-14.949681	G14	10.899449
F14	.000000	G14	-11.763193		9999.000000
F43	.000000	G43	-29.999321		9999.000000
F34	.000000	G34	-28.823325		9999.000000
F 7	.000000	F15	-15.656875	D5#7	10.713983
F24	.000000	G26	-12.938210		9999.000000
F44	.000000	G44	-29.999321		9999.000000
F35	.000000	D5#7	-8.823324		9999.000000
F 8	.000000	G34	-50.000000	G16	10.899449
F16	.000000	G16	-11.763193		9999.000000
F27	.000000	G27	-12.938210		9999.000000
F45	.000000	D5#4	-9.999321		9999.000000
G11	.000000	G22	-1.441442	52#01	11.763190
G25	.000000	F25	-17.861111		9999.000000
G15	.000000	F15	-18.236128		9999.000000
G35	.000000		-9999.000000	D5#7	8.823324
G45	.000000		-9999.000000	D5#4	9.999321
510	.000000	D3#2	-11.640001	521	.000000
51#02	70.000000	D3#2	-9.983554	52#03	.000000
51#03	90.000000	52#03	.000000		9999.000000
511	.000000	521	.000000	G22	1.456000
511#6	90.000000	511#5	.000000	G22	1.441442
512	.000000	522	.000000		9999.000000
512#6	90.000000	512#5	.000000		9999.000000
513	.000000	523#8	.000000		9999.000000
513#8	70.000000	523#8	.000000	D1#9	20.000000
513#9	90.000000	523#9	.000000		9999.000000
514	.000000	524	.000000		9999.000000
514#6	90.000000	524	.000000		9999.000000
520	.000000	521	.000000		9999.000000
52#02	70.000000	52#03	.000000		9999.000000
521#5	70.000000	521#6	.000000	521	.000000
522#5	70.000000	522#6	.000000	522	.000000
523	.000000		-9999.000000	523#8	.000000
524#6	90.000000	524#5	-20.000000	524	.000000
530	.000000	511#5	.000000	521#6	.000000
53#01	50.000000	511#5	.000000	521#6	.000000
53#03	90.000000	613#3	.000000	62#01	.000000
531#6	90.000000	531#5	.000000	531	.000000
532	.000000	612#6	.000000	532#5	.000000
532#6	90.000000	612#6	.000000	622#5	.000000
534	.000000	521#6	.000000	511#5	.000000
534#6	90.000000	521#6	.000000	511#5	.000000
610	.000000	521#6	.000000	511#5	.000000
61#01	50.000000	521#6	.000000	511#5	.000000
61#02	70.000000	53#02	.000000		9999.000000

BEST COPY AVAILABLE

LABEL	COST	LABEL	INCREMENT	LABEL	INCREMENT
		- - - - - - LIMITS OF RANGE - - - - - -			
611	.000000	531	.000000		9999.000000
61105	70.000000	531	.000000		9999.000000
612	.000000	53205	.000000	61206	.000000
61205	70.000000	53205	.000000	63106	.000000
613	.000000	62308	.000000	61309	.000000
61308	70.000000	62308	.000000	0205	20.000000
614	.000000	51105	.000000	52106	.000000
61405	70.000000	51105	.000000	52106	.000000
620	.000000	621	.000000	61309	.000000
62003	90.000000	62001	.000000	61309	.000000
62106	90.000000	62105	.000000	621	.000000
62206	90.000000	62205	.000000	622	.000000
623	.000000	61309	.000000	62308	.000000
62309	90.000000	61309	.000000		9999.000000
62406	90.000000	62405	.000000	624	.000000
630	.000000	52206	.000000	51205	.000000
63001	50.000000	52206	.000000	51205	.000000
63002	70.000000	71002	.000000	72001	.000000
631	.000000	711	.000000		9999.000000
63105	70.000000	63106	.000000		9999.000000
632	.000000	71205	.000000	63206	.000000
63205	70.000000	71205	.000000	72206	.000000
634	.000000	51205	.000000	52206	.000000
63405	70.000000	51205	.000000	52206	.000000
710	.000000	51205	.000000	52206	.000000
71001	50.000000	51205	.000000	52206	.000000
71003	90.000000	63003	.000000		9999.000000
71106	90.000000	71105	.000000	711	.000000
712	.000000	63206	.000000	71205	.000000
71206	90.000000	63206	.000000	73105	.000000
713	.000000	633	-41.177002	720	.000000
71308	70.000000	71307	-20.000000	720	.000000
71309	90.000000	72309	.000000		9999.000000
714	.000000	52206	.000000	51205	.000000
71406	90.000000	52206	.000000	51205	.000000
72002	70.000000	72001	.000000	720	.000000
72105	70.000000	72106	.000000	721	.000000
72205	70.000000	72206	.000000	722	.000000
723	.000000	720	.000000		9999.000000
72308	70.000000	720	.000000		9999.000000
72405	70.000000	72406	.000000	724	.000000
730	.000000	731	.000000	812	.000000
73001	50.000000	73002	.000000	81003	.000000
73003	90.000000	81003	.000000	82001	.000000
73106	90.000000	73105	.000000	731	.000000
732	.000000	812	.000000	F25	17.580300
73206	90.000000	73204	.000000	F25	17.061111
734	.000000	814	.000000		9999.000000

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10 AUG 73 .001.013.004

- - - - - - LIMITS OF RANGE - - - - - -

LABEL	COST	LABEL	INCREMENT	LABEL	INCREMENT
73406	90.000000	73405	.000000		9999.000000
812	.000000	812	.000000	731	.000000
81001	50.000000	81003	.000000	73002	.000000
81002	70.000000	73002	.000000		9999.000000
811	.000000	731	.000000		9999.000000
81105	70.000000	731	.000000		9999.000000
81205	70.000000	81204	.000000	812	.000000
813	.000000	82308	.000000	81309	.000000
81308	70.000000	82308	.000000	D409	20.000000
81405	70.000000	81406	.000000	814	.000000
820	.000000	821	.000000	81309	.000000
82003	90.000000	82001	.000000	81309	.000000
82106	90.000000	82105	.000000	821	.000000
82206	90.000000	82204	.000000	822	.000000
823	.000000	81309	.000000	82308	.000000
82309	90.000000	81309	.000000		9999.000000
82406	90.000000	82405	.000000	824	.000000
832	.000000	910	.000000	921	.000000
83001	50.000000	91001	.000000	92002	.000000
83002	70.000000	91002	.000000		9999.000000
83003	90.000000	910	.000000	91001	.000000
831	.000000	911	.000000	F15	10.420313
83105	70.000000	73204	.000000	81206	.000000
83106	90.000000	81206	.000000	73204	.000000
832	.000000	91205	.000000		9999.000000
83205	70.000000	83206	.000000		9999.000000
834	.000000	923	.000000	910	.000000
83405	70.000000	83406	.000000	910	.000000
91003	90.000000	91001	.000000	910	.000000
91106	90.000000	91104	.000000	911	.000000
912	.000000		-9999.000000	91205	.000000
913	.000000	923	.000000		9999.000000
91307	50.000000	923	.000000	92308	.000000
91308	70.000000	92308	.000000		9999.000000
91309	90.000000	92309	.000000		9999.000000
914	.000000	913	.000000	923	.000000
91406	90.000000	910	.000000	923	.000000
922	.000000	921	.000000		9999.000000
92001	50.000000	92002	.000000		9999.000000
92106	90.000000	92104	.000000	921	.000000
92205	70.000000	92206	.000000	922	.000000
92307	50.000000	92308	.000000	923	.000000
92406	90.000000	92405	.000000	924	.000000
930	.000000	930	-58.025000	G16	11.882001
93001	50.000000	930	-50.000000	G16	10.099449
93002	70.000000	D802	-20.000000		9999.000000
93003	90.000000	D803	-40.000000		9999.000000
931	.000000	G16	-11.882001		9999.000000

18 AUG 73 .001.013.005

		- - - - - - LIMITS OF RANGE - - - - - -			
LABEL	COST	LABEL	INCREMENT	LABEL	INCREMENT
93105	72.000000	G16	-11.763193	83206	.000000
93106	90.000000	83206	.000000		9999.000000
932	.000000	G27	-13.930000		9999.000000
93205	70.000000	G27	-12.930210	D706	20.000000
93206	90.000000	D706	-20.000000		9999.000000
934	.000000	D504	-14.795001		9999.000000
93404	50.000000	73204	.000000		9999.000000
93405	70.000000	93406	.000000	73204	.000000

END PRIMAL RANGE OUTPUT

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REDCST OUTPUT

CASE ITERATION 185 OBJECTIVE VALUE 4130392.7

LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST
Z C510	.000000	40.099447	Z C511	.000000	70.000000	Z C512	.000000	70.000000
Z C513	.000000	70.000000	Z C514	.000000	90.000000	Z C520	.000000	68.099446
Z C521	.000000	70.000000	Z C522	.000000	70.000000	Z C523	.000000	70.000000
Z C524	.000000	90.000000	Z C530	.000000	50.000000	Z C531	.000000	70.000000
Z C532	.000000	70.000000	Z C534	.000000	70.000000	Z C610	.000000	50.000000
Z C611	.000000	70.000000	Z C612	.000000	70.000000	Z C613	.000000	70.000000
Z C614	.000000	70.000000	Z C620	.000000	49.999999	Z C621	.000000	70.000000
Z C622	.000000	70.000000	Z C623	.000000	70.000000	Z C624	.000000	70.000000
Z C630	.000000	50.000000	Z C631	.000000	70.000000	Z C632	.000000	70.000000
Z C634	.000000	70.000000	Z C710	.000000	50.000000	Z C711	.000000	70.000000
Z C712	.000000	70.000000	Z C713	.000000	70.000000	Z C714	.000000	70.000000
Z C720	.000000	49.999999	Z C721	.000000	70.000000	Z C722	.000000	70.000000
Z C723	.000000	70.000000	Z C724	.000000	70.000000	Z C730	.000000	50.000000
Z C731	.000000	70.000000	Z C732	.000000	40.000679	Z C734	.000000	70.000000
Z C810	.000000	50.000000	Z C811	.000000	70.000000	Z C812	.000000	40.000679
Z C813	.000000	70.000000	Z C814	.000000	70.000000	Z C820	.000000	49.999999
Z C821	.000000	70.000000	Z C822	.000000	40.000679	Z C823	.000000	70.000000
Z C824	.000000	70.000000	Z C830	.000000	50.000000	Z C831	.000000	40.000688
Z C832	.000000	70.000000	Z C834	.000000	70.000000	Z C910	.000000	49.999999
Z C911	.000000	40.000679	Z C912	.000000	70.000000	Z C913	.000000	41.176676
Z C914	.000000	70.000000	Z C920	.000000	50.000000	Z C921	.000000	40.000679
Z C922	.000000	70.000000	Z C923	.000000	41.176676	Z C924	.000000	70.000000
Z C930	.000000	50.000000	Z C931	.000000	70.000000	Z C932	.000000	70.000000
Z C934	.000000	40.000679	D302	.000000	9.900554	D303	.000000	29.900553
D106	.000000	20.000000	D206	.000000	20.000000	D109	.000000	20.000000
D402	.000000	20.000001	D403	.000000	40.000001	D306	.000000	20.000000
D209	.000000	20.000000	D502	.000000	20.000001	D503	.000000	40.000001
D406	.000000	20.000000	D305	.000000	20.000000	D602	.000000	20.000001
D603	.000000	40.000001	D504	.000000	9.999321	D505	.000000	29.999321
D506	.000000	40.999321	D409	.000000	20.000000	D702	.000000	20.000001
D703	.000000	40.000001	D606	.000000	20.000000	D507	.000000	8.823324
D508	.000000	20.823324	D509	.000000	40.823324	D802	.000000	20.000000
D803	.000000	40.000001	D706	.000000	20.000000	Z E51	.000000	70.787001
Z E52	.000000	70.726999	Z E53	.000000	50.825000	Z F61	.000000	58.825000
Z E62	.000000	50.824999	Z E63	.000000	58.825000	Z E71	.000000	58.825000
Z E72	.000000	50.824998	Z E73	.000000	58.825000	Z E81	.000000	50.825000
Z E82	.000000	50.824999	Z E83	.000000	50.825000	Z E91	.000000	58.824999
Z E92	.000000	50.825000	Z E93	.000000	58.825000	F25	.000000	17.061111
F15	.000000	10.236120	G22	.000000	1.412350	G31	.000000	20.506891
G40	.000000	41.919625	G12	.000000	11.763193	G23	.000000	12.938210
G41	.000000	29.999321	G32	.000000	20.823325	G13	.000000	11.763193
G24	.000000	12.938210	G42	.000000	29.999321	G33	.000000	20.823325
G14	.000000	11.763193	G43	.000000	29.999321	G34	.000000	20.823325
G26	.000000	12.938210	G44	.000000	29.999321	G16	.000000	11.763193

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10 AUG 73 .001.815.502

LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST	LABEL	COST	REDUCED COST
G27	.000000	12.939210	51A	.000000	70.707001	51001	50.000000	10.099447
51104	50.000000	20.000000	51105	70.000000	.000000	51204	50.000000	20.000000
51205	70.000000	.000000	51307	50.000000	20.000000	51404	50.000000	40.000000
51405	70.000000	20.000000	52A	.000000	70.706999	52001	50.000000	10.099446
52003	90.000000	.000000	521	.000000	.000000	52104	50.000000	20.000000
52106	90.000000	.000000	522	.000000	.000000	52204	50.000000	20.000000
52206	90.000000	.000000	52307	50.000000	20.000000	52308	70.000000	.000000
52309	90.000000	.000000	524	.000000	.000000	52404	50.000000	40.000000
52405	70.000000	20.000000	53A	.000000	58.825000	53002	70.000000	.000000
531	.000000	.000000	53104	50.000000	20.000000	53105	70.000000	.000000
53204	50.000000	20.000000	53205	70.000000	.000000	53404	50.000000	20.000000
53405	70.000000	.000000	61A	.000000	58.825000	61003	90.000000	.000000
61104	50.000000	20.000000	61106	90.000000	.000000	61204	50.000000	20.000000
61206	90.000000	.000000	61307	50.000000	20.000000	61309	90.000000	.000000
61404	50.000000	20.000000	61406	90.000000	.000000	62A	.000000	58.824999
62001	50.000000	.000000	62002	70.000000	.000000	621	.000000	.000000
62104	50.000000	20.000000	62105	70.000000	.000000	622	.000000	.000000
62204	50.000000	20.000000	62205	70.000000	.000000	62307	50.000000	20.000000
62308	70.000000	.000000	624	.000000	.000000	62404	50.000000	20.000000
62405	70.000000	.000000	63A	.000000	58.825000	63003	90.000000	.000000
63104	50.000000	20.000000	63106	90.000000	.000000	63204	50.000000	20.000000
63206	90.000000	.000000	63404	50.000000	20.000000	63406	90.000000	.000000
71A	.000000	58.825000	71002	70.000000	.000000	711	.000000	.000000
71104	50.000000	20.000000	71105	70.000000	.000000	71204	50.000000	20.000000
71205	70.000000	.000000	71307	50.000000	20.000000	71404	50.000000	20.000000
71405	70.000000	.000000	72A	.000000	58.824998	72A	.000000	.000000
72001	50.000000	.000000	72003	90.000000	.000000	721	.000000	.000000
72104	50.000000	20.000000	72106	90.000000	.000000	722	.000000	.000000
72204	50.000000	20.000000	72206	90.000000	.000000	72307	50.000000	20.000000
72309	90.000000	.000000	724	.000000	.000000	72404	50.000000	20.000000
72406	90.000000	.000000	73A	.000000	58.825000	73002	70.000000	.000000
731	.000000	.000000	73104	50.000000	20.000000	73105	70.000000	.000000
73204	50.000000	.000000	73205	70.000000	.000000	73404	50.000000	20.000000
73405	70.000000	.000000	81A	.000000	58.825000	81003	90.000000	.000000
81104	50.000000	20.000000	81106	90.000000	.000000	812	.000000	.000000
81204	50.000000	.000000	81206	90.000000	.000000	81307	50.000000	20.000000
81309	90.000000	.000000	814	.000000	.000000	81404	50.000000	20.000000
81406	90.000000	.000000	82A	.000000	58.824999	82001	50.000000	.000000
82002	70.000000	.000000	821	.000000	.000000	82104	50.000000	20.000000
82105	70.000000	.000000	822	.000000	.000000	82204	50.000000	.000000
82205	70.000000	.000000	82307	50.000000	20.000000	82308	70.000000	.000000
824	.000000	.000000	82404	50.000000	20.000000	82405	70.000000	.000000
83A	.000000	58.825000	83104	50.000000	.000000	83204	50.000000	20.000000
83206	90.000000	.000000	83404	50.000000	20.000000	83406	90.000000	.000000
91A	.000000	58.824999	910	.000000	.000000	91001	50.000000	.000000
91002	70.000000	.000000	911	.000000	.000000	91104	50.000000	.000000
91105	70.000000	.000000	91204	50.000000	19.999999	91205	70.000000	.000000
91206	90.000000	.000000	91404	50.000000	20.000000	91405	70.000000	.000000
92A	.000000	58.825000	92002	70.000000	.000000	92003	90.000000	.000000

BEST COPY AVAILABLE

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10 AUG 73                                                                                                                .001.015.003
      LABEL       COST      REDUCED COST        LABEL       COST      REDUCED COST        LABEL       COST      REDUCED COST
      921         .000000       .000000         92104     50.000000       .000000         92105     70.000000       .000000
      922         .000000       .000000         92204     50.000000     20.000000         92206     90.000000       .000000
      923         .000000       .000000         92308     70.000000       .000000         92309     90.000000       .000000
      924         .000000       .000000         92404     50.000000     20.000000         92405     70.000000       .000000
      93A         .000000     50.825000         93104     50.000000     20.000000         93204     50.000000     20.000000
      93406     90.000000       .000000       Z *B1        .000000 ************
   END REDCST OUTPUT


10 AUG 73                                                                                                                .001.016.001
PRINT END OF TOPOPS LINEAR PROGRAMMING MODULE                                        14:14:13
ENDJOB                                                                               14:14:13
RUN TIME  0 HRS  1 MIN 49 SEC

@@RKPT PUNCHS


@XQT OUTPUT.DATPREP
  0 SCALE CARDS READ--REPORT GENERATOR CONTINUING
     134 SOLUTION AND FLOW VARIABLE ARRAYS FILLED.
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